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# SAR TEST REPORT

**REPORT NO.:** SA110208C15

**MODEL NO.:** WLN-1511 (Refer to item 2.1 for more details)

**FCC ID:** NHPWLN1511

**RECEIVED:** Feb. 08, 2011

**TESTED:** Apr. 13, 2011

**ISSUED:** May 17, 2011

**APPLICANT:** CAMEO COMMUNICATIONS, INC.

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**ISSUED BY:** Bureau Veritas Consumer Products Services  
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## RELEASE CONTROL RECORD

| ISSUE NO.        | REASON FOR CHANGE | DATE ISSUED   |
|------------------|-------------------|---------------|
| Original release | NA                | Mar. 17, 2011 |



## 1. CERTIFICATION

**PRODUCT:** 802.11n Wireless USB2.0 Adapter

**MODEL:** WLN-1511 (Refer to item 2.1 for more details)

**BRAND:** CAMEO (Refer to item 2.1 for more details)

**APPLICANT:** CAMEO COMMUNICATIONS, INC.

**TESTED:** Apr. 13, 2011

**TEST SAMPLE:** ENGINEERING SAMPLE

**STANDARDS:** **FCC Part 2 (Section 2.1093)**

**FCC OET Bulletin 65, Supplement C (01-01)**

**RSS-102 Issue 4 (March 2010)**

The above equipment (model: WLN-1511) has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

**PREPARED BY** : Ivy Lin , **DATE:** May 17, 2011  
Ivy Lin / Specialist

**APPROVED BY** : Gary Chang , **DATE:** May 17, 2011  
Gary Chang / Assistant Manager



## 2. GENERAL INFORMATION

### 2.1 GENERAL DESCRIPTION OF EUT

|                              |  |
|------------------------------|--|
| <b>EUT</b>                   | 802.11n Wireless USB2.0 Adapter  |
| <b>MODEL NO.</b>             | WLN-1511 (Refer to NOTE for more details)  |
| <b>FCC ID</b>                | NHPWLN1511   |
| <b>POWER SUPPLY</b>          | 5Vdc (host equipment)  |
| <b>MODULATION TYPE</b>       | CCK, DQPSK, DBPSK for DSSS<br>64QAM, 16QAM, QPSK, BPSK for OFDM  |
| <b>MODULATION TECHNOLOGY</b> | DSSS, OFDM   |
| <b>TRANSFER RATE</b>         | 802.11b:11.0/ 5.5/ 2.0/ 1.0Mbps<br>802.11g: 54.0/ 48.0/ 36.0/ 24.0/ 18.0/ 12.0/ 9.0/ 6.0Mbps<br>802.11n: up to 270.0Mbps |
| <b>OPERATING FREQUENCY</b>   | 2412 ~ 2462MHz   |
| <b>NUMBER OF CHANNEL</b>     | 11 for 802.11b, 802.11g, 802.11n (20MHz)<br>7 for 802.11n (40MHz)  |
| <b>MAXIMUM SAR (1g)</b>      | 1.070W/kg  |
| <b>ANTENNA TYPE</b>          | PIFA antenna with 2dBi gain  |
| <b>DATA CABLE</b>            | NA   |
| <b>I/O PORTS</b>             | USB  |
| <b>ACCESSORY DEVICES</b>     | NA   |

#### NOTE:

1. All models are electrically identical, different brand and model names are for marketing purpose.

| BRAND NAME | MODEL NO. |
|------------|-----------|
| CAMEO      | WLN-1511  |
| TRENDnet   | TEW-624UB |

2. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

| MODULATION MODE | TX FUNCTION |
|-----------------|-------------|
| 802.11b         | 1TX         |
| 802.11g         | 1TX         |
| 802.11n (20MHz) | 1TX / 2TX   |
| 802.11n (40MHz) | 1TX / 2TX   |

3. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

## **2.2 GENERAL DESCRIPTION OF APPLIED STANDARDS**

According to the specifications of the manufacturer, this product must comply with the requirements of the following standards:

**FCC Part 2 (2.1093)**

**FCC OET Bulletin 65, Supplement C (01- 01)**

**RSS-102 Issue 4 (2010-03)**

**IEEE 1528-2003**

All test items have been performed and recorded as per the above standards.



## 2.3 GENERAL INFORMATION OF THE SAR SYSTEM

DASY4 (software 4.7 Build 80) consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY5 software defined. The DASY4 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC.

### EX3DV4 ISOTROPIC E-FIELD PROBE

|                      |  |
|----------------------|--|
| <b>CONSTRUCTION</b>  | Symmetrical design with triangular core<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE)  |
| <b>FREQUENCY</b>     | 10 MHz to > 6 GHz<br>Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)   |
| <b>DIRECTIVITY</b>   | $\pm 0.3$ dB in HSL (rotation around probe axis)<br>$\pm 0.5$ dB in tissue material (rotation normal to probe axis)  |
| <b>DYNAMIC RANGE</b> | 10 $\mu$ W/g to > 100 mW/g<br>Linearity: $\pm 0.2$ dB (noise: typically < 1 $\mu$ W/g)   |
| <b>DIMENSIONS</b>    | Overall length: 330 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm)<br>Typical distance from probe tip to dipole centers: 1 mm   |
| <b>APPLICATION</b>   | High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%. |

#### NOTE

1. The Probe parameters have been calibrated by the SPEAG. Please reference "APPENDIX D" for the Calibration Certification Report.
2. For frequencies above 800MHz, calibration in a rectangular wave-guide is used, because wave-guide size is manageable.
3. For frequencies below 800MHz, temperature transfer calibration is used because the wave-guide size becomes relatively large.



## TWIN SAM V4.0

|                        |   |
|------------------------|---|
| <b>CONSTRUCTION</b>    | The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, EN 62209-1 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot. |
| <b>SHELL THICKNESS</b> | 2 ± 0.2mm   |
| <b>FILLING VOLUME</b>  | Approx. 25liters  |
| <b>DIMENSIONS</b>      | Height: 810mm; Length: 1000mm; Width: 500mm   |

### SYSTEM VALIDATION KITS:

|                         |  |
|-------------------------|--|
| <b>CONSTRUCTION</b>     | Symmetrical dipole with 1/4 balun enables measurement of feedpoint impedance with NWA matched for use near flat phantoms filled with brain simulating solutions. Includes distance holder and tripod adaptor |
| <b>CALIBRATION</b>      | Calibrated SAR value for specified position and input power at the flat phantom in brain simulating solutions  |
| <b>FREQUENCY</b>        | 2450MHz  |
| <b>RETURN LOSS</b>      | > 20dB at specified validation position  |
| <b>POWER CAPABILITY</b> | > 100W (f < 1GHz); > 40W (f > 1GHz)  |
| <b>OPTIONS</b>          | Dipoles for other frequencies or solutions and other calibration conditions upon request   |





## DEVICE HOLDER FOR SAM TWIN PHANTOM

### CONSTRUCTION

The device holder for the mobile phone device is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles. The holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity  $\epsilon = 3$  and loss tangent  $\delta = 0.02$ . The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered. The device holder for the portable device makes up of the polyethylene foam. The dielectric parameters of material close to the dielectric parameters of the air.

## DATA ACQUISITION ELECTRONICS

### CONSTRUCTION

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplex, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe is mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE3 box is 200M $\Omega$ ; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



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## 2.4 TEST EQUIPMENT

### FOR SAR MEASUREMENT

| ITEM | NAME              | BRAND                | TYPE         | SERIES NO. | DATE OF CALIBRATION | DUE DATE OF CALIBRATION |
|------|-------------------|----------------------|--------------|------------|---------------------|-------------------------|
| 1    | SAM Phantom       | S & P                | QD000 P40 CA | TP-1202    | NA                  | NA                      |
| 2    | Signal Generator  | Agilent              | E4438C       | MY45092849 | Dec. 01, 2010       | Nov. 30, 2011           |
| 3    | E-Field Probe     | S & P                | EX3DV4       | 3590       | Feb. 25, 2011       | Feb. 24, 2012           |
| 4    | DAE               | S & P                | DAE 3        | 579        | Sep. 20, 2010       | Sep. 19, 2011           |
| 5    | Robot Positioner  | Staubli<br>Unimation | NA           | NA         | NA                  | NA                      |
| 6    | Validation Dipole | S & P                | D2450V2      | 716        | Jan. 26, 2011       | Jan. 25, 2012           |

**NOTE:** Before starting the measurement, all test equipment shall be warmed up for 30min.

### FOR TISSUE PROPERTY

| ITEM | NAME             | BRAND   | TYPE   | SERIES NO. | DATE OF CALIBRATION | DUE DATE OF CALIBRATION |
|------|------------------|---------|--------|------------|---------------------|-------------------------|
| 1    | Network Analyzer | Agilent | E5071C | MY46104190 | Apr. 06, 2010       | Apr. 05, 2011           |
| 2    | Dielectric Probe | Agilent | 85070D | US01440176 | NA                  | NA                      |

**NOTE:**

1. Before starting, all test equipment shall be warmed up for 30min.
2. The tolerance ( $k=1$ ) specified by Agilent for general dielectric measurements, deriving from inaccuracies in the calibration data, analyzer drift, and random errors, are usually  $\pm 2.5\%$  and  $\pm 5\%$  for measured permittivity and conductivity, respectively. However, the tolerances for the conductivity is smaller for material with large loss tangents, i.e., less than  $\pm 2.5\%$  ( $k=1$ ). It can be substantially smaller if more accurate methods are applied.

## 2.5 GENERAL DESCRIPTION OF THE SPATIAL PEAK SAR EVALUATION

The DASY4 post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the micro-volt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

|                    |                           |   |
|--------------------|---------------------------|---|
| Probe parameters:  | - Sensitivity             | Norm <sub>i</sub> , a <sub>i0</sub> , a <sub>i1</sub> , a <sub>i2</sub> |
|                    | - Conversion factor       | ConvF <sub>i</sub>  |
|                    | - Diode compression point | dcp <sub>i</sub>  |
| Device parameters: | - Frequency               | F   |
|                    | - Crest factor            | Cf  |
| Media parameters:  | - Conductivity            | $\sigma$  |
|                    | - Density                 | $\rho$  |

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

|                  |                                  |                  |
|------------------|----------------------------------|------------------|
| V <sub>i</sub>   | =compensated signal of channel i | (i = x, y, z)    |
| U <sub>i</sub>   | =input signal of channel i       | (i = x, y, z)    |
| Cf               | =crest factor of exciting field  | (DASY parameter) |
| dcp <sub>i</sub> | =diode compression point         | (DASY parameter) |

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E-field probes: } E_i = \sqrt{\frac{V_i}{\text{Norm}_i \cdot \text{ConvF}}}$$

$$\text{H-field probes: } H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

- $V_i$  = compensated signal of channel  $i$  ( $i = x, y, z$ )
- $\text{Norm}_i$  = sensor sensitivity of channel  $i$   $\mu\text{V}/(\text{V/m})^2$  for E-field Probes ( $i = x, y, z$ )
- $\text{ConvF}$  = sensitivity enhancement in solution
- $a_{ij}$  = sensor sensitivity factors for H-field probes
- $f$  = carrier frequency [GHz]
- $E_i$  = electric field strength of channel  $i$  in V/m
- $H_i$  = magnetic field strength of channel  $i$  in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

- $SAR$  = local specific absorption rate in mW/g
- $E_{tot}$  = total field strength in V/m
- $\sigma$  = conductivity in [mho/m] or [Siemens/m]
- $\rho$  = equivalent tissue density in g/cm<sup>3</sup>

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid. The entire evaluation of the spatial peak values is performed within the Post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. The extraction of the measured data (grid and values) from the Zoom Scan
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1g and 10g.

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.



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The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 7 x 7 x 7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements. The measured volume of 30 x 30 x 30mm contains about 30g of tissue. The first procedure is an extrapolation (incl. boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume in a 1mm grid (42875 points). In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is the moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

## 2.6 DESCRIPTION OF SUPPORT UNITS

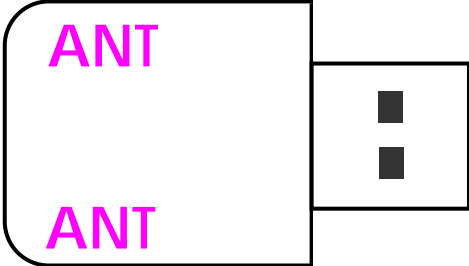
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| NO. | PRODUCT  | BRAND | MODEL NO. | SERIAL NO.  | FCC ID           |
|-----|----------|-------|-----------|-------------|------------------|
| 1   | NOTEBOOK | DELL  | PP18L     | 29144041120 | CXSMM01BRD02D330 |

| NO. | SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS |
|-----|---|
| 1   | NA  |

**NOTE:** All power cords of the above support units are non shielded (1.8m).

**3. DESCRIPTION OF ANTENNA LOCATION**



#### 4. RECIPES FOR TISSUE SIMULATING LIQUIDS

For the measurement of the field distribution inside the SAM phantom, the phantom must be filled with 25 liters of tissue simulation liquid.

The following ingredients are used :

- **WATER-** Deionized water (pure H<sub>2</sub>O), resistivity  $\approx 16$  M - as basis for the liquid
- **DGMBE-** Diethylenglycol-monobuthyl ether (DGMBE), Fluka Chemie GmbH, CAS # 112-34-5 - to reduce relative permittivity

**THE RECIPES FOR 2450MHz SIMULATING LIQUID TABLE**

| INGREDIENT                     | BODY SIMULATING LIQUID 2450MHz (MSL-2450)                              |
|--------------------------------|--|
| Water                          | 69.83%   |
| DGMBE                          | 30.17%   |
| Dielectric Parameters at 22 °C | f= 2450MHz<br>$\epsilon = 52.7 \pm 5\%$<br>$\sigma = 1.95 \pm 5\%$ S/m |



Testing the liquids using the Agilent Network Analyzer E5071C and Agilent Dielectric Probe Kit 85070D. The testing procedure is following as

1. Turn Network Analyzer on and allow at least 30min. warm up.
2. Mount dielectric probe kit so that interconnecting cable to Network Analyzer will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature ( $\pm 1^\circ$ ).
4. Set water temperature in Agilent-Software (Calibration Setup).
5. Perform calibration.
6. Validate calibration with dielectric material of known properties (e.g. polished ceramic slab with  $>8\text{mm}$  thickness  $\epsilon' = 10.0$ ,  $\epsilon'' = 0.0$ ). If measured parameters do not fit within tolerance, repeat calibration ( $\pm 0.2$  for  $\epsilon'$ :  $\pm 0.1$  for  $\epsilon''$ ).
7. Conductivity can be calculated from  $\epsilon''$  by  $\sigma = \omega \epsilon_0 \epsilon'' = \epsilon'' f [\text{GHz}] / 18$ .
8. Measure liquid shortly after calibration. Repeat calibration every hour.
9. Stir the liquid to be measured. Take a sample ( $\sim 50\text{ml}$ ) with a syringe from the center of the liquid container.
10. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
11. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
12. Perform measurements.
13. Adjust medium parameters in DASY4 for the frequencies necessary for the measurements ('Setup Config', select medium and press 'Option'-button.)
14. Select the current medium for the frequency of the validation.

**FOR 2.4GHz BAND SIMULATING LIQUID**

| <b>LIQUID TYPE</b>             |                                  | MSL-2450              |                          |                             |                 |
|--------------------------------|----------------------------------|-----------------------|--------------------------|-----------------------------|-----------------|
| <b>SIMULATING LIQUID TEMP.</b> |                                  | 21.2                  |                          |                             |                 |
| <b>TEST DATE</b>               |                                  | Apr. 13, 2011         |                          |                             |                 |
| <b>TESTED BY</b>               |                                  | Van Lin               |                          |                             |                 |
| <b>FREQ. (MHz)</b>             | <b>LIQUID PARAMETER</b>          | <b>STANDARD VALUE</b> | <b>MEASUREMENT VALUE</b> | <b>ERROR PERCENTAGE (%)</b> | <b>LIMIT(%)</b> |
| 2412                           | Permittivity<br>( $\epsilon$ )   | 52.75                 | 55.05                    | 4.36                        | ±5              |
| 2422                           |                                  | 52.74                 | 55.02                    | 4.32                        |                 |
| 2437                           |                                  | 52.72                 | 54.97                    | 4.27                        |                 |
| 2450                           |                                  | 52.70                 | 54.76                    | 3.91                        |                 |
| 2452                           |                                  | 52.70                 | 54.75                    | 3.89                        |                 |
| 2462                           |                                  | 52.68                 | 54.62                    | 3.68                        |                 |
| 2412                           | Conductivity<br>( $\sigma$ ) S/m | 1.91                  | 1.96                     | 2.62                        |                 |
| 2422                           |                                  | 1.92                  | 1.97                     | 2.60                        |                 |
| 2437                           |                                  | 1.94                  | 1.99                     | 2.58                        |                 |
| 2450                           |                                  | 1.95                  | 2.01                     | 3.08                        |                 |
| 2452                           |                                  | 1.95                  | 2.01                     | 3.08                        |                 |
| 2462                           |                                  | 1.97                  | 2.02                     | 2.54                        |                 |

## 5. SYSTEM VALIDATION

The system validation was performed in the flat phantom with equipment listed in the following table. Since the SAR value is calculated from the measured electric field, dielectric constant and conductivity of the body tissue and the SAR is proportional to the square of the electric field. So, the SAR value will be also proportional to the RF power input to the system validation dipole under the same test environment. In our system validation test, 250mW RF input power was used.

### 5.1 TEST PROCEDURE

Before the system performance check, we need only to tell the system which components (probe, medium, and device) are used for the system performance check; the system will take care of all parameters. The dipole must be placed beneath the flat section of the SAM Twin Phantom with the correct distance holder in place. The distance holder should touch the phantom surface with a light pressure at the reference marking (little cross) and be oriented parallel to the long side of the phantom. Accurate positioning is not necessary, since the system will search for the peak SAR location, except that the dipole arms should be parallel to the surface. The device holder for mobile phones can be left in place but should be rotated away from the dipole.

1. The "Power Reference Measurement" and "Power Drift Measurement" jobs are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the amplifier output power. If it is too high (above  $\pm 0.1$  dB), the system performance check should be repeated; some amplifiers have very high drift during warm-up. A stable amplifier gives drift results in the DASY system below  $\pm 0.02$ dB.
2. The "Surface Check" job tests the optical surface detection system of the DASY system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above  $\pm 0.1$ mm). In that case it is better to abort the system performance check and stir the liquid.



- 3. The "Area Scan" job measures the SAR above the dipole on a plane parallel to the surface. It is used to locate the approximate location of the peak SAR. The proposed scan uses large grid spacing for faster measurement; due to the symmetric field, the peak detection is reliable. If a finer graphic is desired, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result.
- 4. The "Zoom Scan" job measures the field in a volume around the peak SAR value assessed in the previous "Area Scan" job (for more information see the application note on SAR evaluation).

About the validation dipole positioning uncertainty, the constant and low loss dielectric spacer is used to establish the correct distance between the top surface of the dipole and the bottom surface of the phantom, the error component introduced by the uncertainty of the distance between the liquid (i.e., phantom shell) and the validation dipole in the DASy4 system is less than ±0.1mm.

$$SAR_{tolerance} [\%] = 100 \times \left( \frac{(a + d)^2}{a^2} - 1 \right)$$

As the closest distance is 10mm, the resulting tolerance SAR<sub>tolerance</sub>[%] is <2%.

## 5.2 VALIDATION RESULTS

| SYSTEM VALIDATION TEST OF SIMULATING LIQUID |                     |                     |               |                     |               |
|---|---------------------|---------------------|---------------|---------------------|---------------|
| FREQUENCY (MHz)                             | REQUIRED SAR (mW/g) | MEASURED SAR (mW/g) | DEVIATION (%) | SEPARATION DISTANCE | TESTED DATE   |
| MSL2450                                     | 13.40 (1g)          | 12.50               | -6.72         | 10mm                | Apr. 13, 2011 |

**NOTE:** Please see Appendix for the photo of system validation test.

### 5.3 SYSTEM VALIDATION UNCERTAINTIES

In the table below, the system validation uncertainty with respect to the analytically assessed SAR value of a dipole source as given in the IEEE 1528 standard is given. This uncertainty is smaller than the expected uncertainty for mobile phone measurements due to the simplified setup and the symmetric field distribution.

| Error Description                            | Tolerance (±%) | Probability Distribution | Divisor    | (C <sub>i</sub> ) |       | Standard Uncertainty (±%) |              | (v <sub>i</sub> ) |
|--|----------------|--------------------------|------------|-------------------|-------|---------------------------|--------------|-------------------|
|  |                |                          |            | (1g)              | (10g) | (1g)                      | (10g)        |                   |
| <b>Measurement System</b>                    |                |                          |            |                   |       |                           |              |                   |
| Probe Calibration                            | 5.50           | Normal                   | 1          | 1                 | 1     | 5.50                      | 5.50         | ∞                 |
| Axial Isotropy                               | 0.25           | Rectangular              | $\sqrt{3}$ | 0.7               | 0.7   | 0.10                      | 0.10         | ∞                 |
| Hemispherical Isotropy                       | 1.30           | Rectangular              | $\sqrt{3}$ | 0.7               | 0.7   | 0.53                      | 0.53         | ∞                 |
| Boundary effects                             | 1.00           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 0.58                      | 0.58         | ∞                 |
| Linearity                                    | 0.30           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 0.17                      | 0.17         | ∞                 |
| System Detection Limits                      | 1.00           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 0.58                      | 0.58         | ∞                 |
| Readout Electronics                          | 0.30           | Normal                   | 1          | 1                 | 1     | 0.30                      | 0.30         | ∞                 |
| Response Time                                | 0.80           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 0.46                      | 0.46         | ∞                 |
| Integration Time                             | 2.60           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 1.50                      | 1.50         | ∞                 |
| RF Ambient Noise                             | 3.00           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 1.73                      | 1.73         | 9                 |
| RF Ambient Reflections                       | 3.00           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 1.73                      | 1.73         | 9                 |
| Probe Positioner                             | 0.40           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 0.23                      | 0.23         | ∞                 |
| Probe Positioning                            | 2.90           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 1.67                      | 1.67         | ∞                 |
| Max. SAR Eval.                               | 1.00           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 0.58                      | 0.58         | ∞                 |
| <b>Test sample related</b>                   |                |                          |            |                   |       |                           |              |                   |
| Sample positioning                           | 1.90           | Normal                   | 1          | 1                 | 1     | 1.90                      | 1.90         | 4                 |
| Device holder uncertainty                    | 2.80           | Normal                   | 1          | 1                 | 1     | 2.80                      | 2.80         | 4                 |
| Output power variation-SAR drift measurement | 4.50           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 2.60                      | 2.60         | 1                 |
| <b>Dipole Related</b>                        |                |                          |            |                   |       |                           |              |                   |
| Dipole Axis to Liquid Distance               | 1.60           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 0.92                      | 0.92         | 4                 |
| Input Power Drift                            | 0.14           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 0.08                      | 0.08         | 1                 |
| <b>Phantom and Tissue parameters</b>         |                |                          |            |                   |       |                           |              |                   |
| Phantom Uncertainty                          | 4.00           | Rectangular              | $\sqrt{3}$ | 1                 | 1     | 2.31                      | 2.31         | ∞                 |
| Liquid Conductivity (target)                 | 5.00           | Rectangular              | $\sqrt{3}$ | 0.64              | 0.43  | 1.85                      | 1.24         | ∞                 |
| Liquid Conductivity (measurement)            | 3.08           | Normal                   | 1          | 0.64              | 0.43  | 1.97                      | 1.32         | 9                 |
| Liquid Permittivity (target)                 | 5.00           | Rectangular              | $\sqrt{3}$ | 0.6               | 0.49  | 1.73                      | 1.41         | ∞                 |
| Liquid Permittivity (measurement)            | 4.36           | Normal                   | 1          | 0.6               | 0.49  | 2.62                      | 2.14         | 9                 |
| <b>Combined Standard Uncertainty</b>         |                |                          |            |                   |       | <b>9.19</b>               | <b>8.79</b>  |                   |
| <b>Coverage Factor for 95%</b>               |                |                          |            |                   |       | <b>Kp=2</b>               |              |                   |
| <b>Expanded Uncertainty (K=2)</b>            |                |                          |            |                   |       | <b>18.39</b>              | <b>17.58</b> |                   |

## 6. TEST RESULTS

### 6.1 TEST PROCEDURES

The EUT plugged into the notebook. Use the software to control the EUT channel and transmission power. Then record the conducted power before the testing. Place the EUT to the specific test location. After the testing, must writing down the conducted power of the EUT into the report. The SAR value was calculated via the 3D spline interpolation algorithm that has been implemented in the software of DASY4 SAR measurement system manufactured and calibrated by SPEAG. According to the IEEE 1528 standards, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- Power reference measurement
- Verification of the power reference measurement
- Area scan
- Zoom scan
- Power reference measurement

The area scan was performed for the highest spatial SAR location. The zoom scan was performed for SAR value averaged over 1g and 10g spatial volumes.



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In the zoom scan, the distance between the measurement point at the probe sensor location (geometric center behind the probe tip) and the phantom surface is 2mm and maintained at a constant distance of  $\pm 0.5$ mm during a zoom scan to determine peak SAR locations. The distance is 2mm between the first measurement point and the bottom surface of the phantom.

The measurement time is 0.5s at each point of the zoom scan. The probe boundary effect compensation shall be applied during the SAR test. Because of the tip of the probe to the Phantom surface separated distances are longer than half a tip probe diameter.

In the area scan, the separation distance is 2mm between the each measurement point and the phantom surface. The scan size shall be included the transmission portion of the EUT. The measurement time is the same as the zoom scan. At last the reference power drift shall be less than  $\pm 5\%$ .



## 6.2 CONDUCTED POWER

| TEST MODE |             |                 |                  | 802.11b |      |
|-----------|-------------|-----------------|------------------|---------|------|
| CHAN.     | FREQ. (MHz) | MODULATION TYPE | DATA RATE (Mbps) | AVG     | PEAK |
| 1         | 2412 (Low)  | DBPSK           | 1                | 13.8    | 16.1 |
| 6         | 2437 (Mid.) | DBPSK           | 1                | 13.4    | 15.7 |
| 11        | 2462 (High) | DBPSK           | 1                | 13.4    | 15.8 |

| TEST MODE |             |                 |                  | 802.11g |      |
|-----------|-------------|-----------------|------------------|---------|------|
| CHAN.     | FREQ. (MHz) | MODULATION TYPE | DATA RATE (Mbps) | AVG     | PEAK |
| 1         | 2412 (Low)  | BPSK            | 6                | 13.0    | 22.1 |
| 6         | 2437 (Mid.) | BPSK            | 6                | 13.9    | 22.9 |
| 11        | 2462 (High) | BPSK            | 6                | 13.5    | 22.6 |

| TEST MODE |             |                 |                  | 802.11n (20MHz) |      |
|-----------|-------------|-----------------|------------------|-----------------|------|
| CHAN.     | FREQ. (MHz) | MODULATION TYPE | DATA RATE (Mbps) | AVG             | PEAK |
| 1         | 2412 (Low)  | BPSK            | 7.2              | 15.8            | 24.0 |
| 6         | 2437 (Mid.) | BPSK            | 7.2              | 16.7            | 24.8 |
| 11        | 2462 (High) | BPSK            | 7.2              | 16.3            | 24.4 |

| TEST MODE |             |                 |                  | 802.11n (40MHz) |      |
|-----------|-------------|-----------------|------------------|-----------------|------|
| CHAN.     | FREQ. (MHz) | MODULATION TYPE | DATA RATE (Mbps) | AVG             | PEAK |
| 1         | 2422 (Low)  | BPSK            | 15               | 16.1            | 24.1 |
| 4         | 2437 (Mid.) | BPSK            | 15               | 16.4            | 24.4 |
| 7         | 2452 (High) | BPSK            | 15               | 16.3            | 24.4 |

## 6.3 DESCRIPTION OF TEST CONDITION

| TEST DATE     | TEMPERATURE(°C) |        | HUMIDITY(%RH) | TESTED BY |
|---------------|-----------------|--------|---------------|-----------|
|               | AIMBENT         | LIQUID |               |           |
| Apr. 13, 2011 | 22.3            | 21.2   | 58            | Van Lin   |





## 6.4 MEASURED SAR RESULT

| Distance between EUT and phantom is 5mm |             |                 |                |               |               |       |
|---|-------------|-----------------|----------------|---------------|---------------|-------|
| CHAN.                                   | FREQ. (MHz) | Horizontal-Down | Vertical-Front | Horizontal-Up | Vertical-Back | TIP   |
| <b>802.11b</b>                          |             |                 |                |               |               |       |
| 1                                       | 2412 (Low)  | 0.622           | 0.139          | 0.803         | 0.408         | 0.444 |
| 6                                       | 2437 (Mid.) | -               | -              | 0.911         | -             | -     |
| 11                                      | 2462 (High) | -               | -              | 0.718         | -             | -     |
| <b>802.11g</b>                          |             |                 |                |               |               |       |
| 1                                       | 2412 (Low)  | -               | -              | 0.822         | -             | -     |
| 6                                       | 2437 (Mid.) | 0.675           | 0.141          | <b>1.070</b>  | 0.424         | 0.442 |
| 11                                      | 2462 (High) | -               | -              | 0.869         | -             | -     |
| <b>802.11n (20MHz)</b>                  |             |                 |                |               |               |       |
| 1                                       | 2412 (Low)  | -               | -              | 0.963         | -             | -     |
| 6                                       | 2437 (Mid.) | 0.716           | 0.290          | 1.050         | 0.334         | 0.425 |
| 11                                      | 2462 (High) | -               | -              | 0.828         | -             | -     |
| <b>802.11n (40MHz)</b>                  |             |                 |                |               |               |       |
| 1                                       | 242 (Low)   | -               | -              | 0.989         | -             | -     |
| 4                                       | 2437 (Mid.) | 0.693           | 0.280          | 0.990         | 0.324         | 0.395 |
| 7                                       | 245 (High)  | -               | -              | 0.902         | -             | -     |

### NOTE:

1. In this testing, the limit for General Population Spatial Peak averaged over 1g, 1.6 W/kg, is applied.
2. Please see the Appendix A for the data.
3. The variation of the EUT conducted power measured before and after SAR testing should not over 5%.
4. Per KDB 447498, when 1-g SAR for the highest output channel is less than 0.8 W/kg, testing for the other channels is not required.



### 6.5 POWER DRIFT TABLE

| Test Mode | Test Position          | Communication Mode | Test Channel | Test Frequency | Power (dBm) |       | Power Drift (%) |
|-----------|------------------------|--------------------|--------------|----------------|-------------|-------|-----------------|
|           |                        |                    |              |                | Begin       | After |                 |
| 1         | Horizontal-Down<br>5mm | 802.11b            | 1            | 2412           | 13.8        | 13.7  | -2.28           |
| 2         |                        | 802.11g            | 6            | 2462           | 13.9        | 13.8  | -2.28           |
| 3         |                        | 802.11n (20MHz)    | 6            | 2462           | 16.7        | 16.6  | -2.28           |
| 4         |                        | 802.11n (40MHz)    | 4            | 2437           | 16.4        | 16.3  | -2.28           |
| 5         | Vertical-Front<br>5mm  | 802.11b            | 1            | 2412           | 13.8        | 13.7  | -2.28           |
| 6         |                        | 802.11g            | 6            | 2462           | 13.9        | 13.8  | -2.28           |
| 7         |                        | 802.11n (20MHz)    | 6            | 2462           | 16.7        | 16.6  | -2.28           |
| 8         |                        | 802.11n (40MHz)    | 4            | 2437           | 16.4        | 16.3  | -2.28           |
| 9         | Horizontal-Up<br>5mm   | 802.11b            | 1            | 2412           | 13.8        | 13.7  | -2.28           |
|           |                        |                    | 6            | 2437           | 13.4        | 13.3  | -2.28           |
|           |                        |                    | 11           | 2462           | 13.4        | 13.3  | -2.28           |
| 10        |                        | 802.11g            | 1            | 2412           | 13          | 12.9  | -2.28           |
|           |                        |                    | 6            | 2437           | 13.9        | 13.8  | -2.28           |
|           |                        |                    | 11           | 2462           | 13.5        | 13.4  | -2.28           |
| 11        |                        | 802.11n (20MHz)    | 1            | 2412           | 15.8        | 15.7  | -2.28           |
|           |                        |                    | 6            | 2437           | 16.7        | 16.6  | -2.28           |
|           |                        |                    | 11           | 2462           | 16.3        | 16.2  | -2.28           |
| 12        |                        | 802.11n (40MHz)    | 1            | 2422           | 16.1        | 16.0  | -2.28           |
|           |                        |                    | 4            | 2437           | 16.4        | 16.3  | -2.28           |
|           |                        |                    | 7            | 2452           | 16.3        | 16.2  | -2.28           |
| 13        | Vertical-Back<br>5mm   | 802.11b            | 1            | 2412           | 13.8        | 13.7  | -2.28           |
| 14        |                        | 802.11g            | 6            | 2462           | 13.9        | 13.8  | -2.28           |
| 15        |                        | 802.11n (20MHz)    | 6            | 2462           | 16.7        | 16.6  | -2.28           |
| 16        |                        | 802.11n (40MHz)    | 4            | 2437           | 16.4        | 16.3  | -2.28           |
| 17        | Tip 5mm                | 802.11b            | 1            | 2412           | 13.8        | 13.7  | -2.28           |
| 18        |                        | 802.11g            | 6            | 2462           | 13.9        | 13.8  | -2.28           |
| 19        |                        | 802.11n (20MHz)    | 6            | 2462           | 16.7        | 16.6  | -2.28           |
| 20        |                        | 802.11n (40MHz)    | 4            | 2437           | 16.4        | 16.3  | -2.28           |



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## 6.6 SAR LIMITS

| HUMAN EXPOSURE   | SAR (W/kg)   |  |
|--|--|--|
|  | (GENERAL POPULATION / UNCONTROLLED EXPOSURE ENVIRONMENT) | (OCCUPATIONAL / CONTROLLED EXPOSURE ENVIRONMENT) |
| Spatial Average (whole body)                                     | 0.08   | 0.4  |
| Spatial Peak (averaged over 1 g)                                 | <b>1.6</b>   | 8.0  |
| Spatial Peak (hands / wrists / feet / ankles averaged over 10 g) | 4.0  | 20.0   |

**NOTE:** This limits accord to 47 CFR 2.1093 – Safety Limit.



## 7. INFORMATION ON THE TESTING LABORATORIES

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

Copies of accreditation certificates of our laboratories obtained from approval agencies can be downloaded from our web site: [www.adt.com.tw/index.5.phtml](http://www.adt.com.tw/index.5.phtml). If you have any comments, please feel free to contact us at the following:

**Linko EMC/RF Lab:**

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**Web Site:** [www.adt.com.tw](http://www.adt.com.tw)

The address and road map of all our labs can be found in our web site also.

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Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

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## APPENDIX A: TEST DATA

Product Name: 802.11n Wireless USB 2.0 Adapter ; Type: WLN-1511

### Liquid Level Photo

Tissue 2450MHz D=150mm



## M01-11b-Ch1

Communication System: 802.11b ; Frequency: 2412 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 55.05$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Horizontal-down side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Low Channel 1/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.987 mW/g

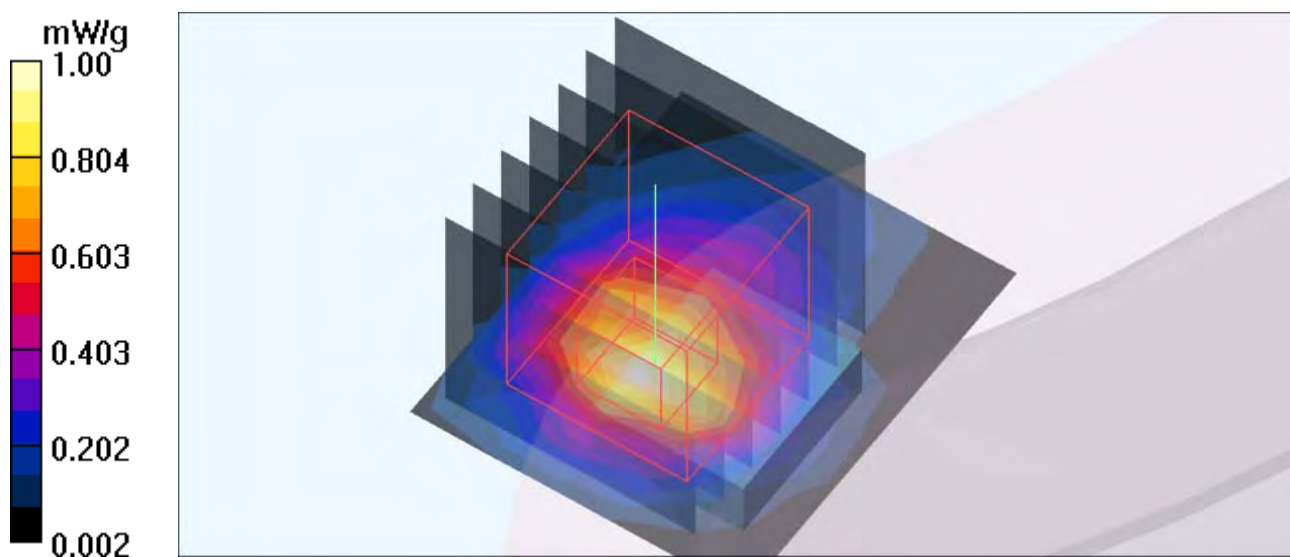
**Body Position - Low Channel 1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 22.8 V/m; Power Drift = -0.102 dB

Peak SAR (extrapolated) = 1.45 W/kg

**SAR(1 g) = 0.622 mW/g; SAR(10 g) = 0.268 mW/g**

Maximum value of SAR (measured) = 1.00 mW/g



## M02-11g-Ch6

Communication System: 802.11g ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK  
Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Horizontal-down side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 6/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.05 mW/g

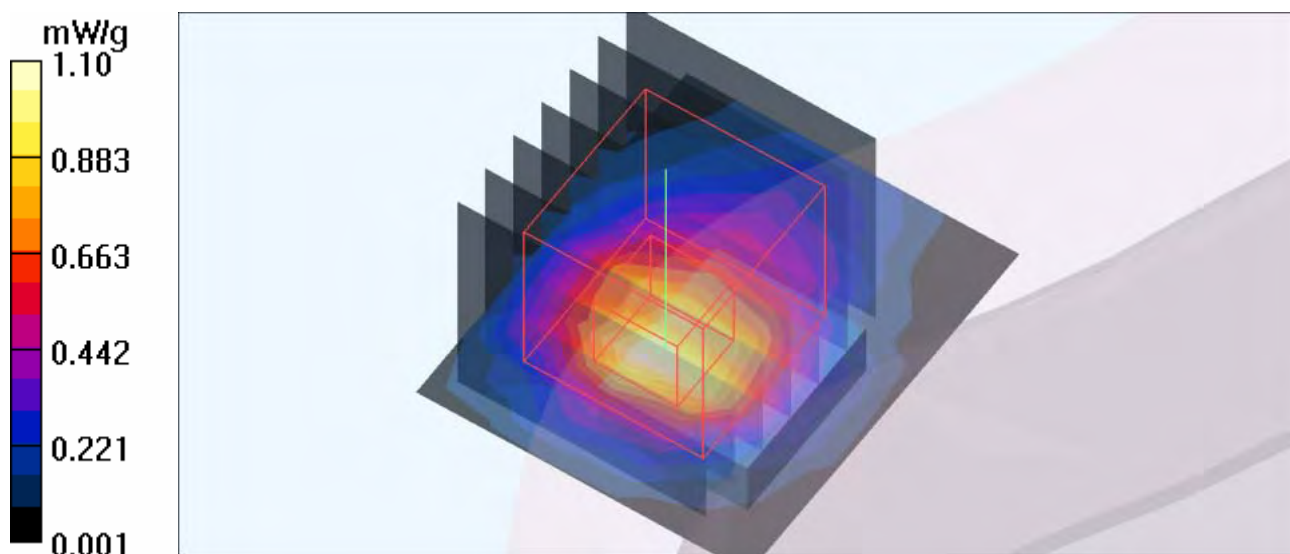
**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 23.4 V/m; Power Drift = -0.026 dB

Peak SAR (extrapolated) = 1.60 W/kg

**SAR(1 g) = 0.675 mW/g; SAR(10 g) = 0.293 mW/g**

Maximum value of SAR (measured) = 1.10 mW/g



## M03-11n20-Ch6

Communication System: 802.11n 20MHz ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Horizontal-down side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 6/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.38 mW/g

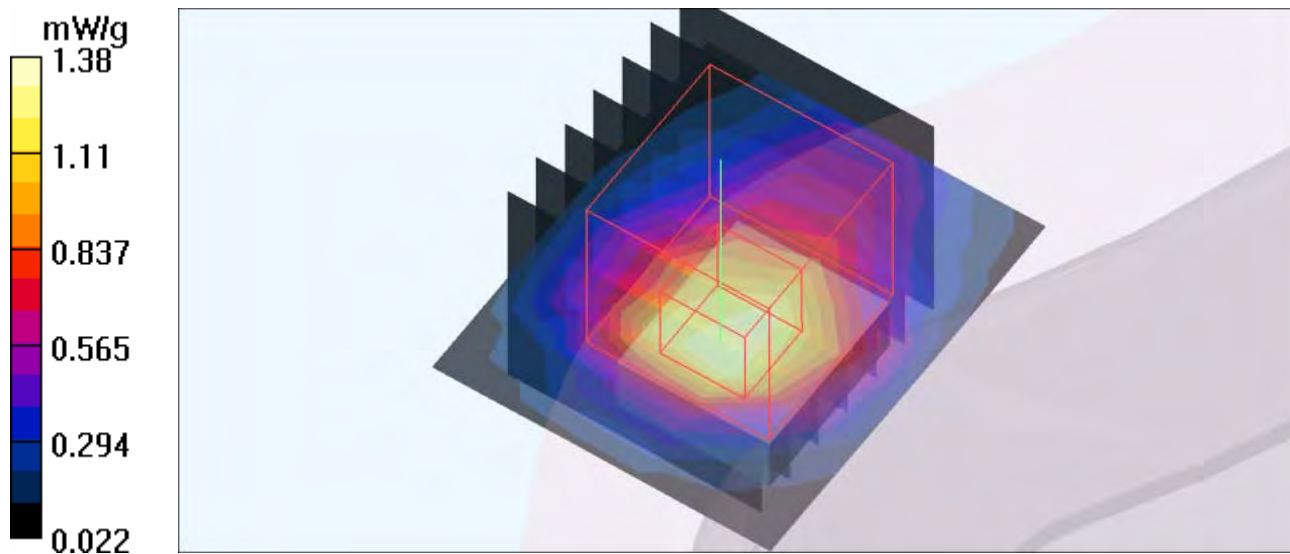
**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 34.4 V/m; Power Drift = -0.130 dB

Peak SAR (extrapolated) = 1.72 W/kg

**SAR(1 g) = 0.716 mW/g; SAR(10 g) = 0.321 mW/g**

Maximum value of SAR (measured) = 1.17 mW/g





## M04-11n40-Ch4

Communication System: 802.11n 40MHz ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Horizontal-down side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 4/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.04 mW/g

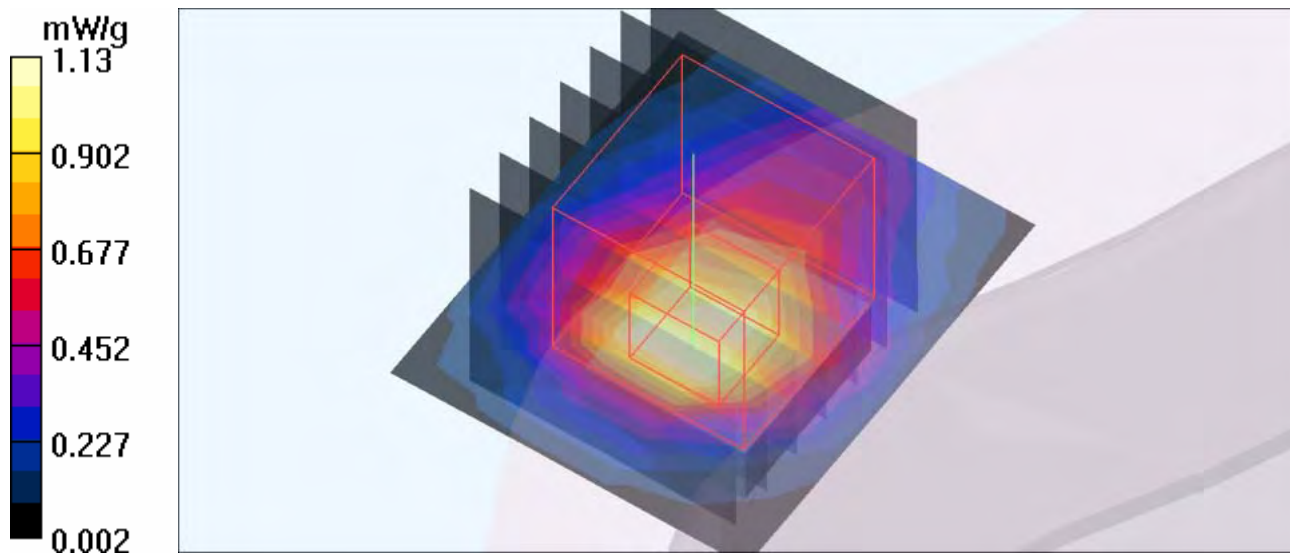
**Body Position - Mid Channel 4/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 25.6 V/m; Power Drift = -0.127 dB

Peak SAR (extrapolated) = 1.67 W/kg

**SAR(1 g) = 0.693 mW/g; SAR(10 g) = 0.310 mW/g**

Maximum value of SAR (measured) = 1.13 mW/g



## M05-11b-Ch1

Communication System: 802.11b ; Frequency: 2412 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 55.05$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Vertical-front side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Low Channel 1/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.233 mW/g

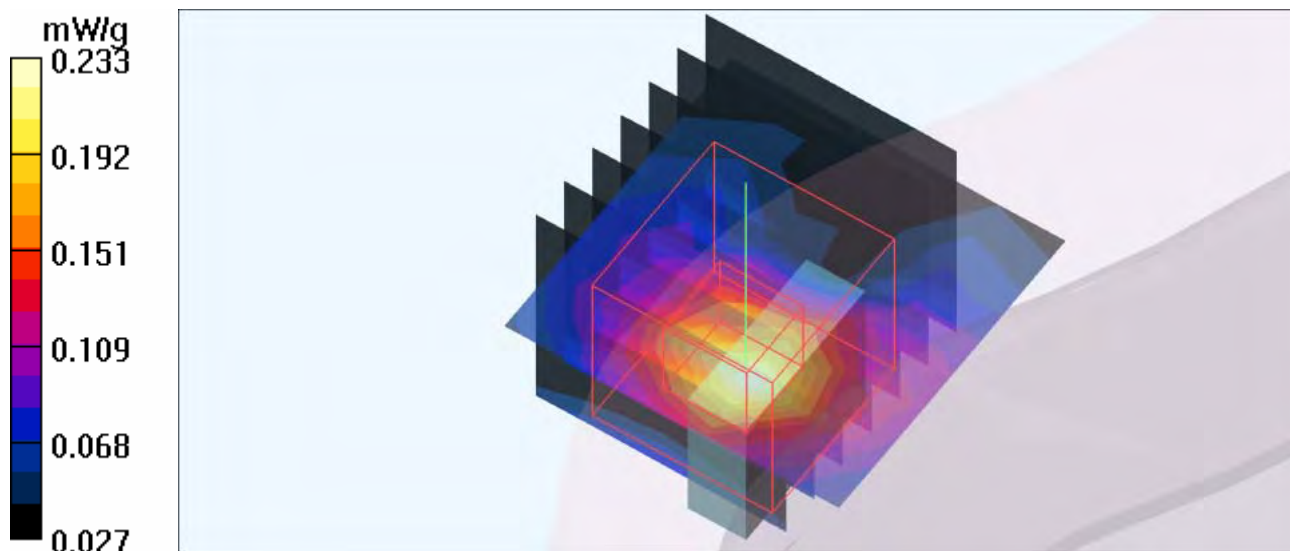
**Body Position - Low Channel 1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 11.5 V/m; Power Drift = -0.152 dB

Peak SAR (extrapolated) = 0.383 W/kg

**SAR(1 g) = 0.139 mW/g; SAR(10 g) = 0.057 mW/g**

Maximum value of SAR (measured) = 0.243 mW/g



## M06-11g-Ch6

Communication System: 802.11g ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK  
Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Vertical-front side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 6/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.234 mW/g

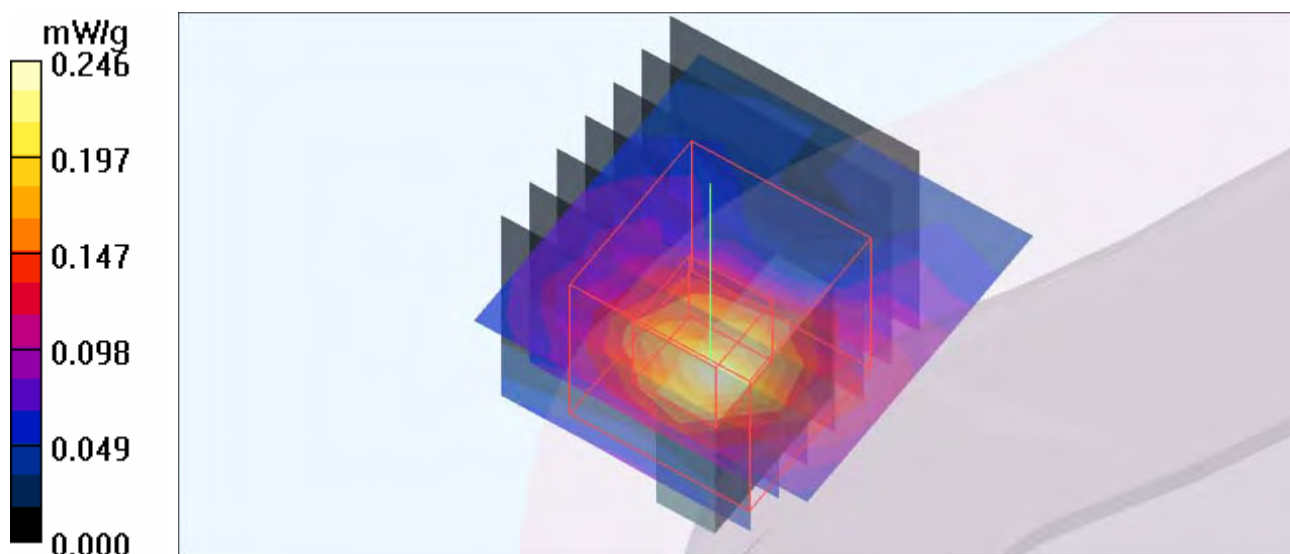
**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 11.4 V/m; Power Drift = -0.168 dB

Peak SAR (extrapolated) = 0.388 W/kg

**SAR(1 g) = 0.141 mW/g; SAR(10 g) = 0.057 mW/g**

Maximum value of SAR (measured) = 0.246 mW/g



## M07-11n20-Ch6

Communication System: 802.11n 20MHz ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Vertical-front side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

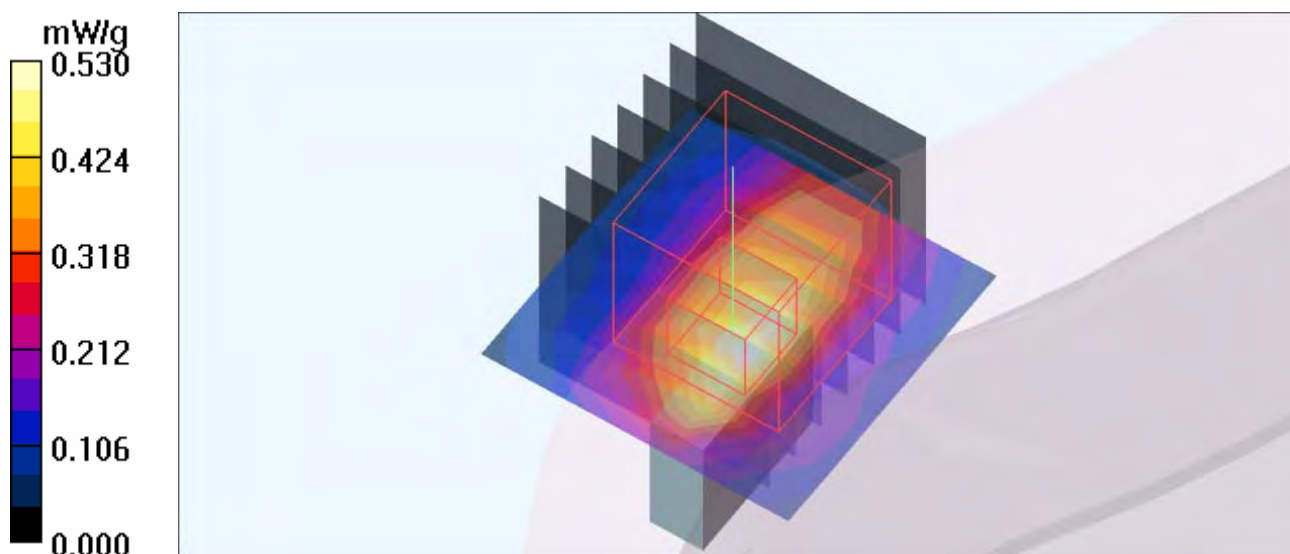
**Body Position - Mid Channel 6/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.530 mW/g

**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 17.9 V/m; Power Drift = -0.145 dB

Peak SAR (extrapolated) = 0.779 W/kg

SAR(1 g) = **0.290** mW/g; SAR(10 g) = 0.121 mW/g



## M08-11n40-Ch4

Communication System: 802.11n 40MHz ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Vertical-front side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 4/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.432 mW/g

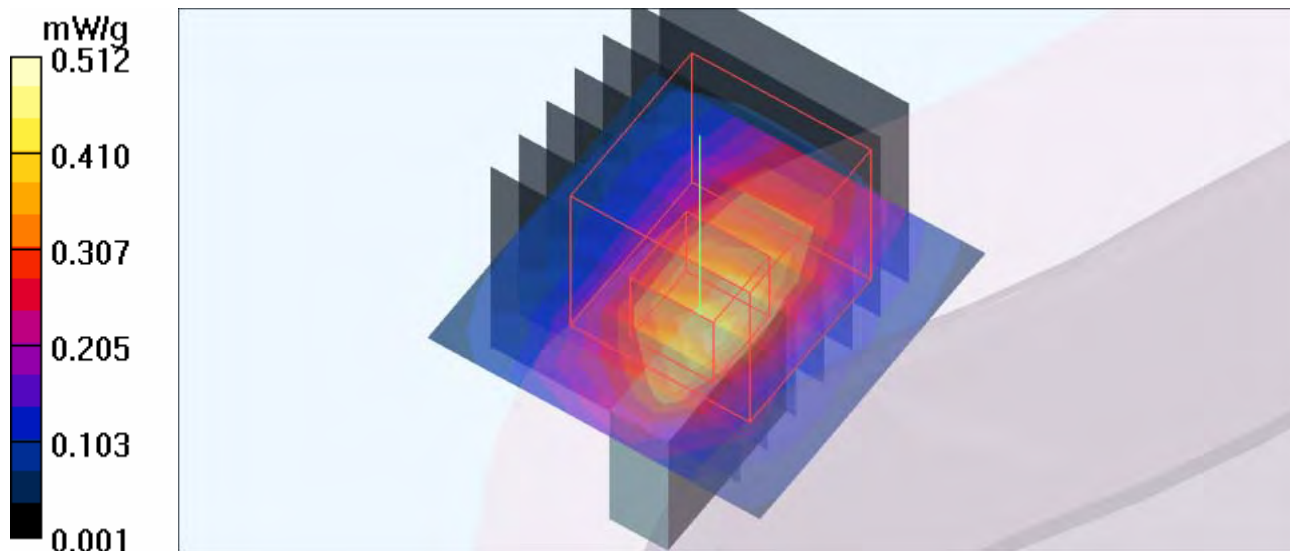
**Body Position - Mid Channel 4/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 14.5 V/m; Power Drift = -0.163 dB

Peak SAR (extrapolated) = 0.757 W/kg

**SAR(1 g) = 0.280 mW/g; SAR(10 g) = 0.117 mW/g**

Maximum value of SAR (measured) = 0.512 mW/g





## M09-11b-Ch1

Communication System: 802.11b ; Frequency: 2412 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 55.05$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Low Channel 1/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.16 mW/g

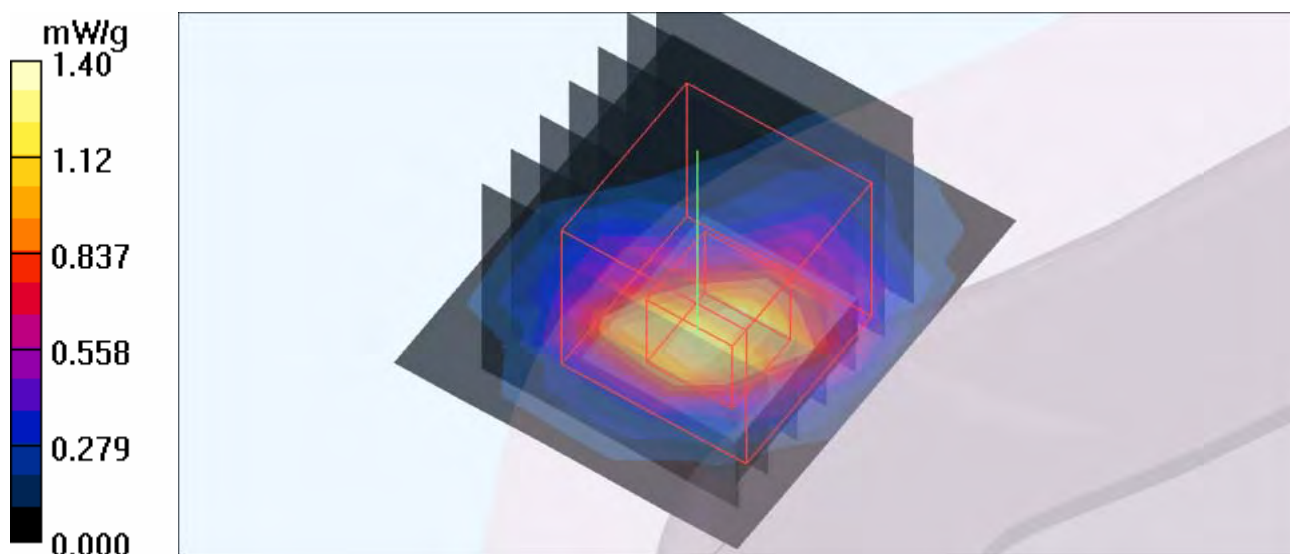
**Body Position - Low Channel 1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 25.6 V/m; Power Drift = -0.151 dB

Peak SAR (extrapolated) = 2.10 W/kg

**SAR(1 g) = 0.803 mW/g; SAR(10 g) = 0.312 mW/g**

Maximum value of SAR (measured) = 1.40 mW/g



## M09-11b-Ch6

Communication System: 802.11b ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 6/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.30 mW/g

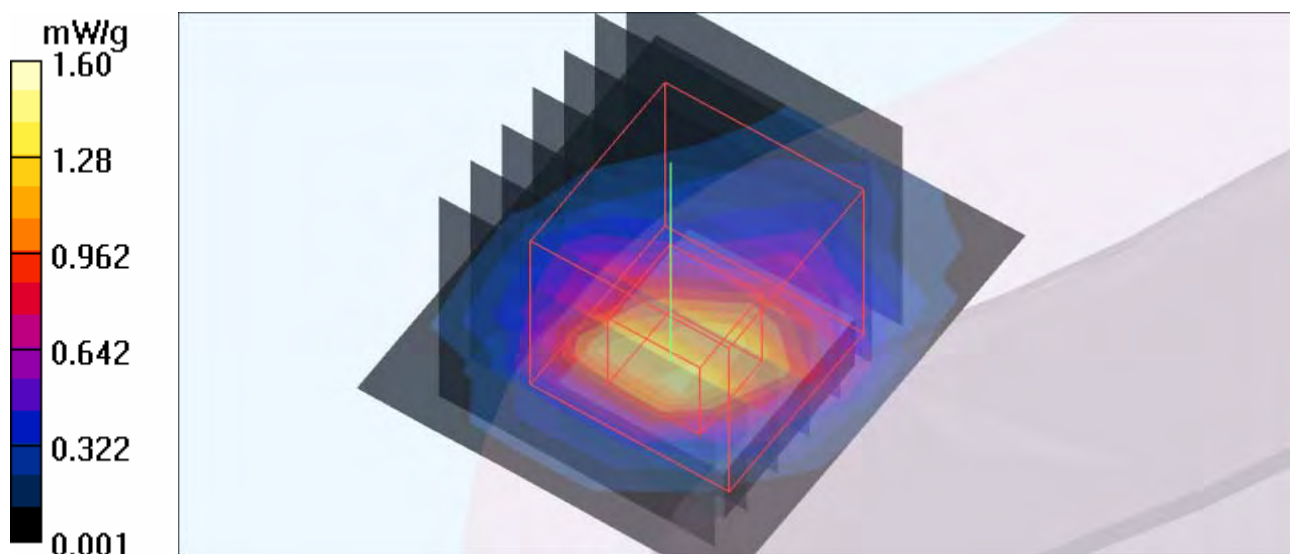
**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 26.9 V/m; Power Drift = 0.061 dB

Peak SAR (extrapolated) = 2.43 W/kg

**SAR(1 g) = 0.911 mW/g; SAR(10 g) = 0.358 mW/g**

Maximum value of SAR (measured) = 1.60 mW/g



## M09-11b-Ch11

Communication System: 802.11b ; Frequency: 2462 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2462$  MHz;  $\sigma = 2.02$  mho/m;  $\epsilon_r = 54.62$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - High Channel 11/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.01 mW/g

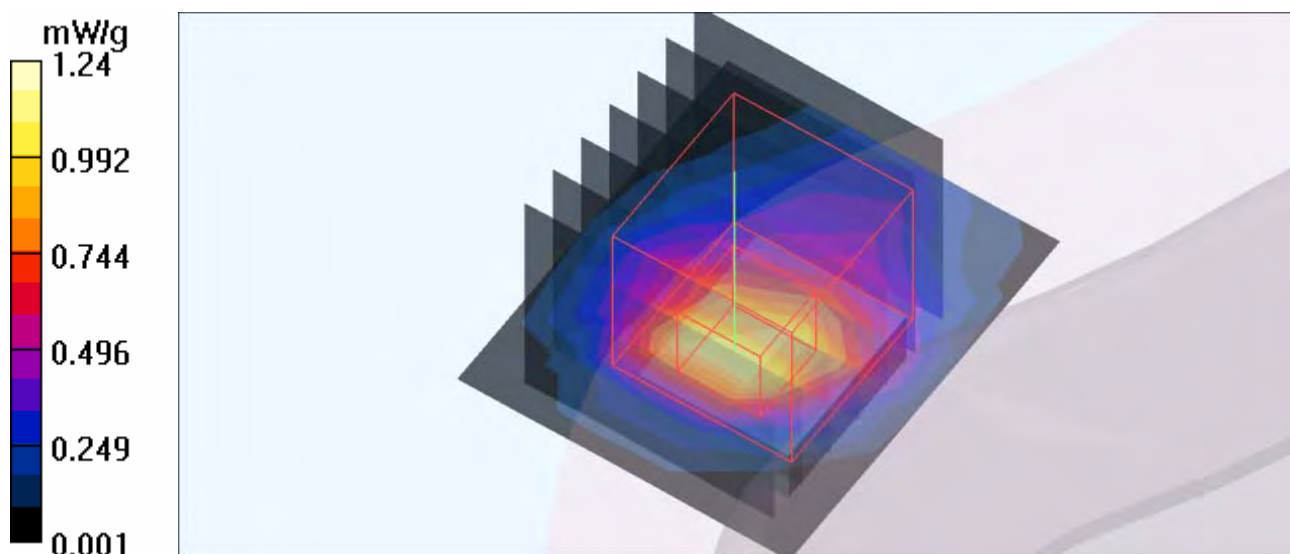
**Body Position - High Channel 11/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 24.0 V/m; Power Drift = -0.004 dB

Peak SAR (extrapolated) = 1.88 W/kg

**SAR(1 g) = 0.718 mW/g; SAR(10 g) = 0.292 mW/g**

Maximum value of SAR (measured) = 1.24 mW/g





## M10-11g-Ch1

Communication System: 802.11g ; Frequency: 2412 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK  
Medium: MSL2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 55.05$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Low Channel 1/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.45 mW/g

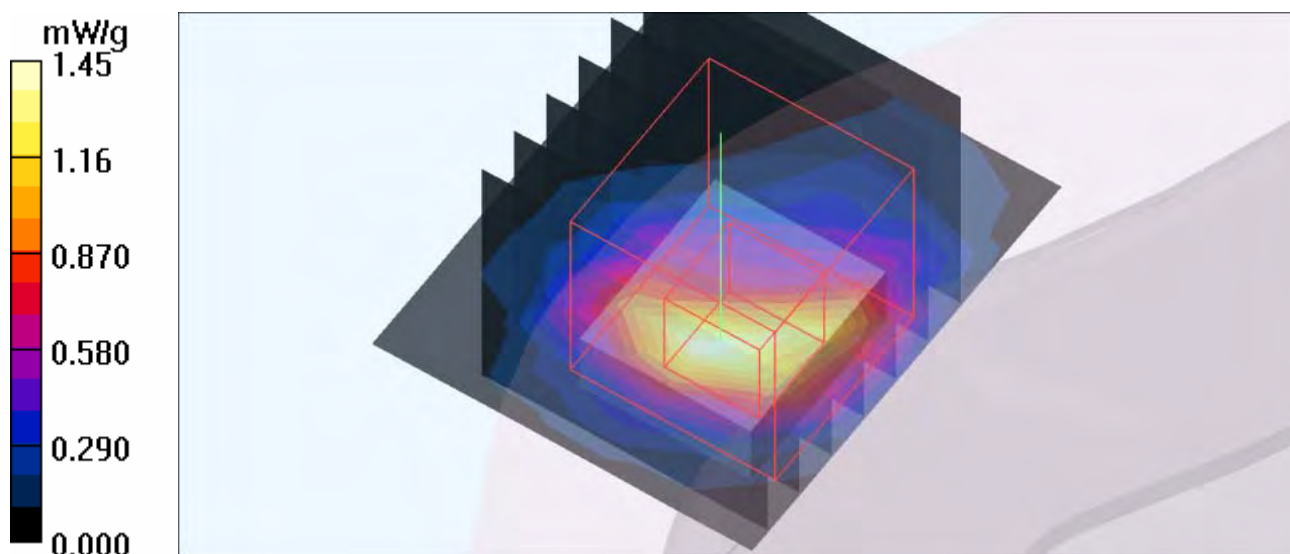
**Body Position - Low Channel 1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 26.7 V/m; Power Drift = -0.113 dB

Peak SAR (extrapolated) = 2.22 W/kg

**SAR(1 g) = 0.822 mW/g; SAR(10 g) = 0.316 mW/g**

Maximum value of SAR (measured) = 1.44 mW/g



## M10-11g-Ch6

Communication System: 802.11g ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK  
Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 6/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 2.11 mW/g

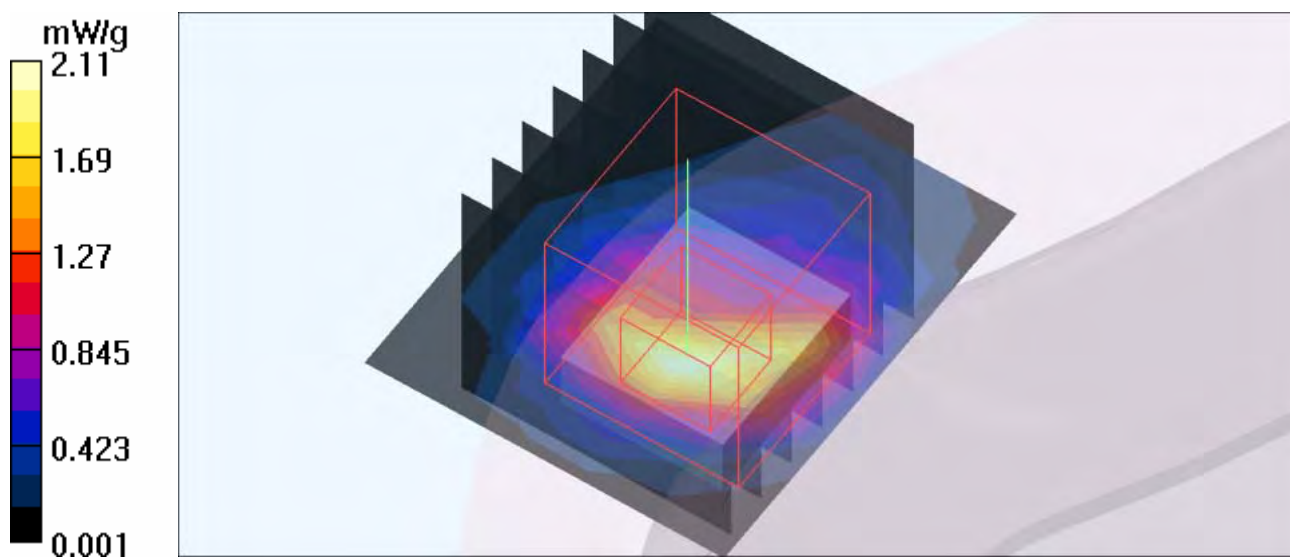
**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

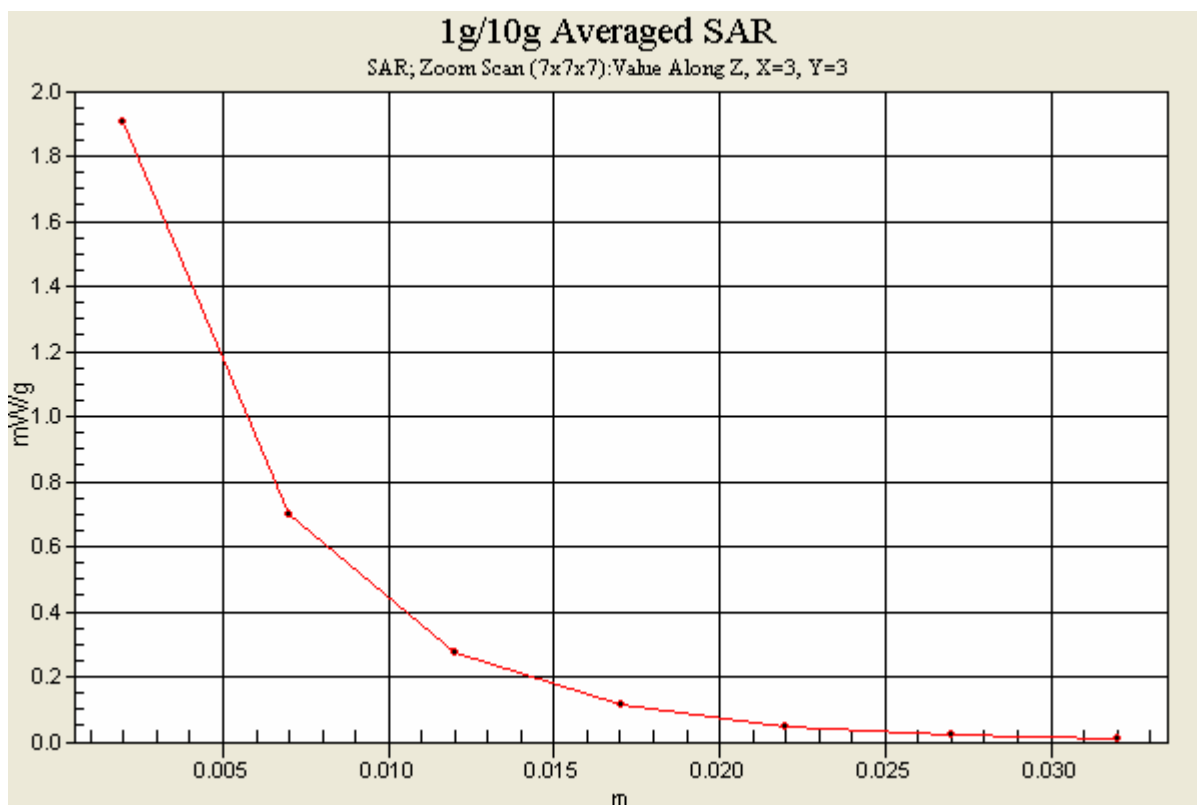
Reference Value = 33.6 V/m; Power Drift = -0.141 dB

Peak SAR (extrapolated) = 2.92 W/kg

**SAR(1 g) = 1.07 mW/g; SAR(10 g) = 0.420 mW/g**

Maximum value of SAR (measured) = 1.91 mW/g





## M10-11g-Ch11

Communication System: 802.11g ; Frequency: 2462 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK  
Medium: MSL2450 Medium parameters used:  $f = 2462$  MHz;  $\sigma = 2.02$  mho/m;  $\epsilon_r = 54.62$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - High Channel 11/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.51 mW/g

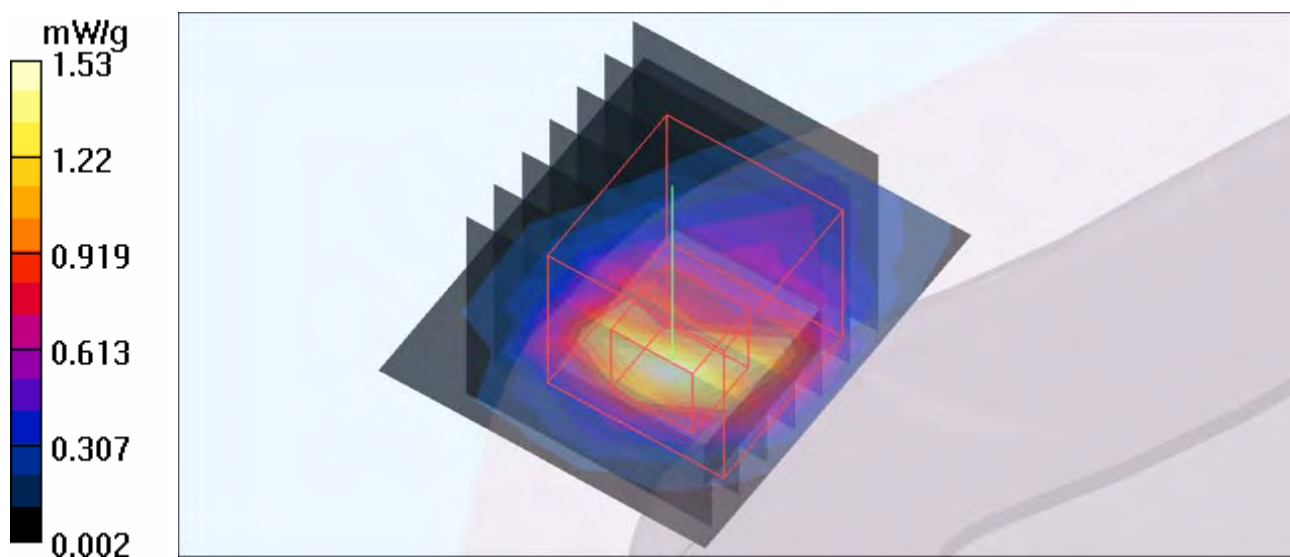
**Body Position - High Channel 11/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 27.6 V/m; Power Drift = -0.134 dB

Peak SAR (extrapolated) = 2.37 W/kg

**SAR(1 g) = 0.869 mW/g; SAR(10 g) = 0.349 mW/g**

Maximum value of SAR (measured) = 1.53 mW/g



## M11-11n20-Ch1

Communication System: 802.11n 20MHz ; Frequency: 2412 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 55.05$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Low Channel 1/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.69 mW/g

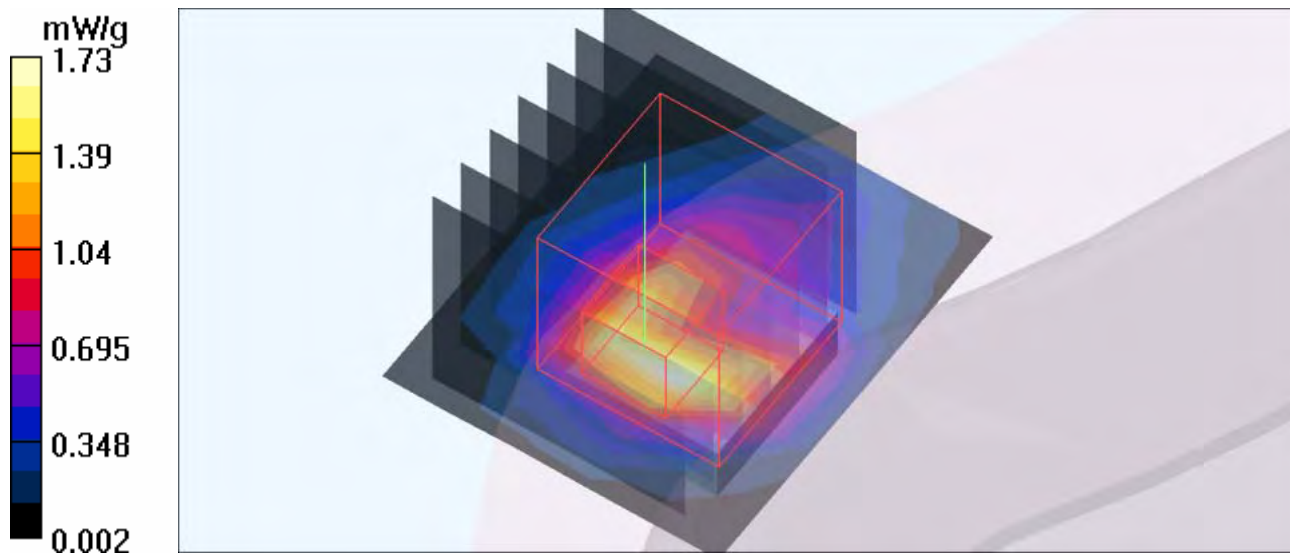
**Body Position - Low Channel 1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 31.4 V/m; Power Drift = -0.156 dB

Peak SAR (extrapolated) = 2.69 W/kg

**SAR(1 g) = 0.963 mW/g; SAR(10 g) = 0.396 mW/g**

Maximum value of SAR (measured) = 1.73 mW/g



## M11-11n20-Ch6

Communication System: 802.11n 20MHz ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 6/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 2.26 mW/g

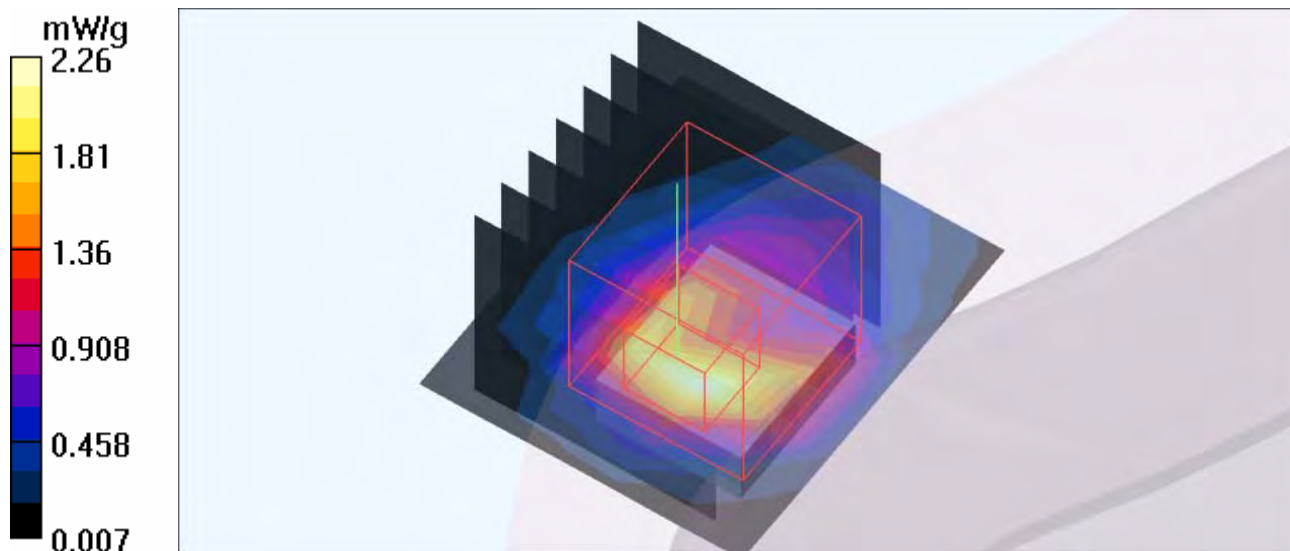
**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 39.2 V/m; Power Drift = -0.112 dB

Peak SAR (extrapolated) = 2.94 W/kg

**SAR(1 g) = 1.05 mW/g; SAR(10 g) = 0.432 mW/g**

Maximum value of SAR (measured) = 1.89 mW/g





## M11-11n20-Ch11

Communication System: 802.11n 20MHz ; Frequency: 2462 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2462$  MHz;  $\sigma = 2.02$  mho/m;  $\epsilon_r = 54.62$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - High Channel 11/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.47 mW/g

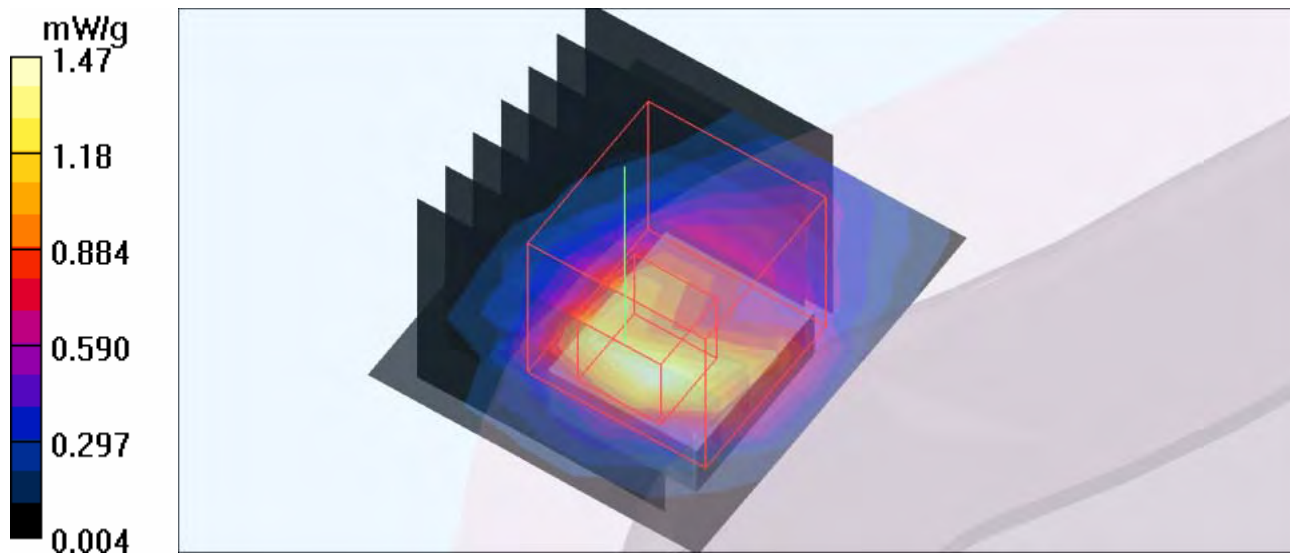
**Body Position - High Channel 11/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 29.3 V/m; Power Drift = -0.179 dB

Peak SAR (extrapolated) = 2.28 W/kg

**SAR(1 g) = 0.828 mW/g; SAR(10 g) = 0.347 mW/g**

Maximum value of SAR (measured) = 1.46 mW/g



## M12-11n40-Ch1

Communication System: 802.11n 40MHz ; Frequency: 2422 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used :  $f = 2422$  MHz;  $\sigma = 1.97$  mho/m;  $\epsilon_r = 55.02$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Low Channel 1/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.78 mW/g

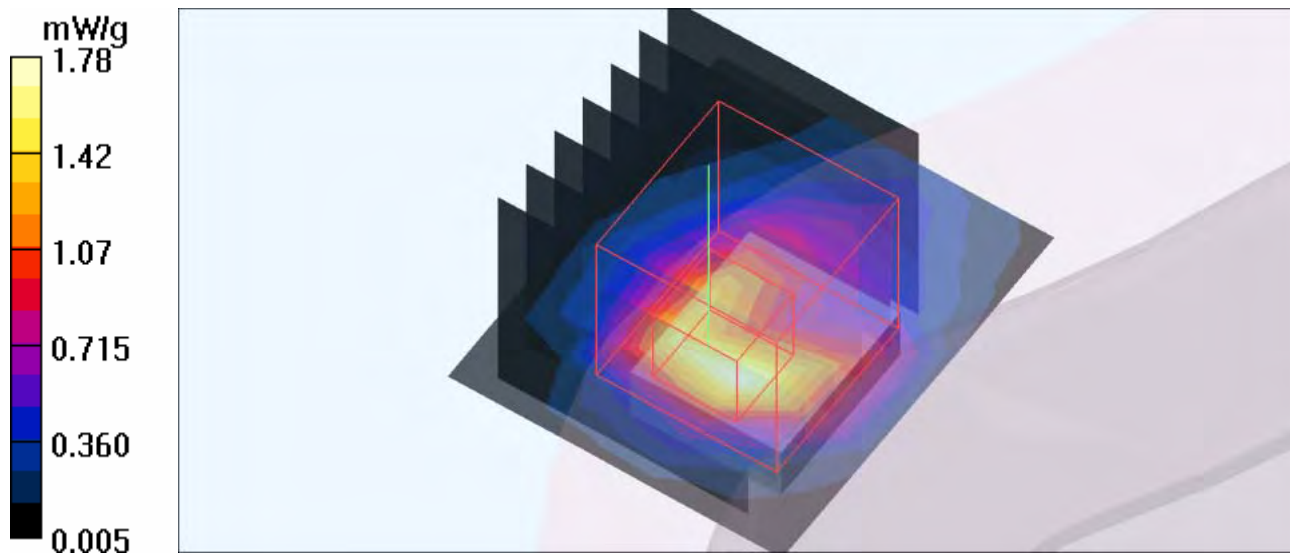
**Body Position - Low Channel 1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 31.9 V/m; Power Drift = -0.156 dB

Peak SAR (extrapolated) = 2.75 W/kg

**SAR(1 g) = 0.989 mW/g; SAR(10 g) = 0.405 mW/g**

Maximum value of SAR (measured) = 1.77 mW/g





## M12-11n40-Ch4

Communication System: 802.11n 40MHz ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 4/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.76 mW/g

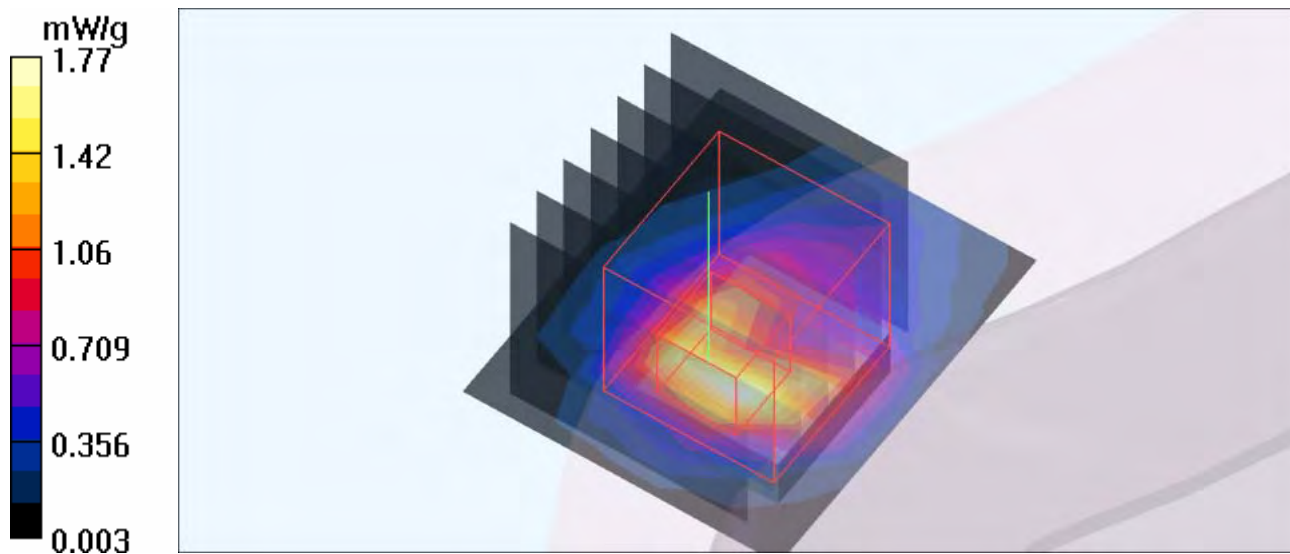
**Body Position - Mid Channel 4/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 31.0 V/m; Power Drift = -0.160 dB

Peak SAR (extrapolated) = 2.76 W/kg

**SAR(1 g) = 0.990 mW/g; SAR(10 g) = 0.406 mW/g**

Maximum value of SAR (measured) = 1.77 mW/g



## M12-11n40-Ch7

Communication System: 802.11n 40MHz ; Frequency: 2452 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used :  $f = 2452$  MHz;  $\sigma = 2.01$  mho/m;  $\epsilon_r = 54.75$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The horizontal-up side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - High Channel 7/Area Scan (6x7x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 1.59 mW/g

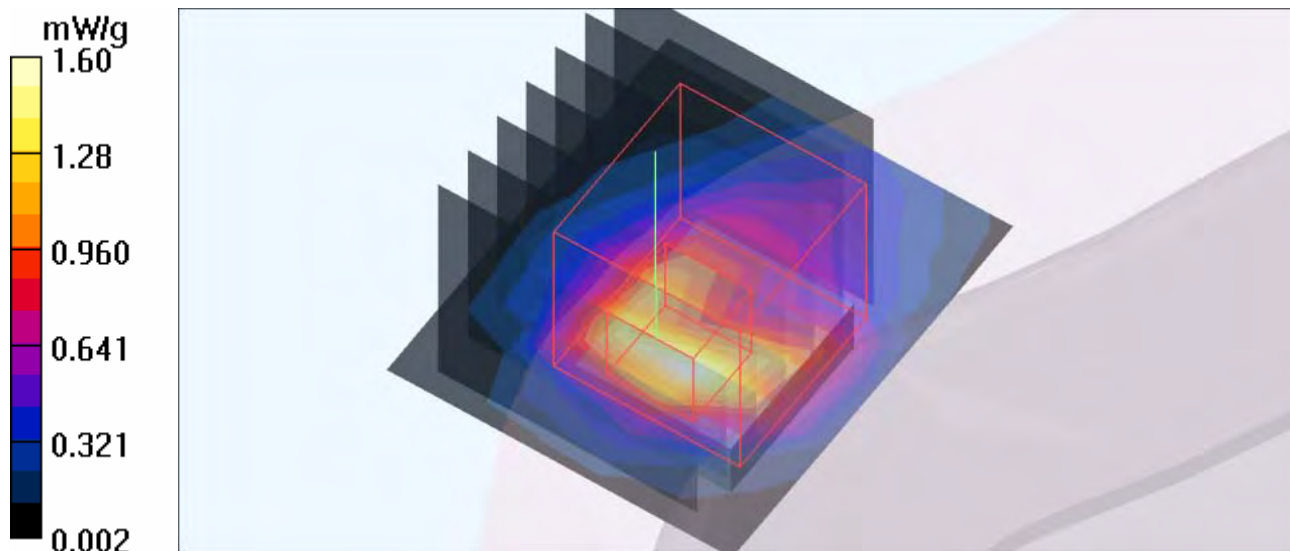
**Body Position - High Channel 7/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 30.3 V/m; Power Drift = -0.168 dB

Peak SAR (extrapolated) = 2.52 W/kg

**SAR(1 g) = 0.902 mW/g; SAR(10 g) = 0.373 mW/g**

Maximum value of SAR (measured) = 1.60 mW/g



## M13-11b-Ch1

Communication System: 802.11b ; Frequency: 2412 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 55.05$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Separation distance : 5 mm (The Vertical-back side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Low Channel 1/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.607 mW/g

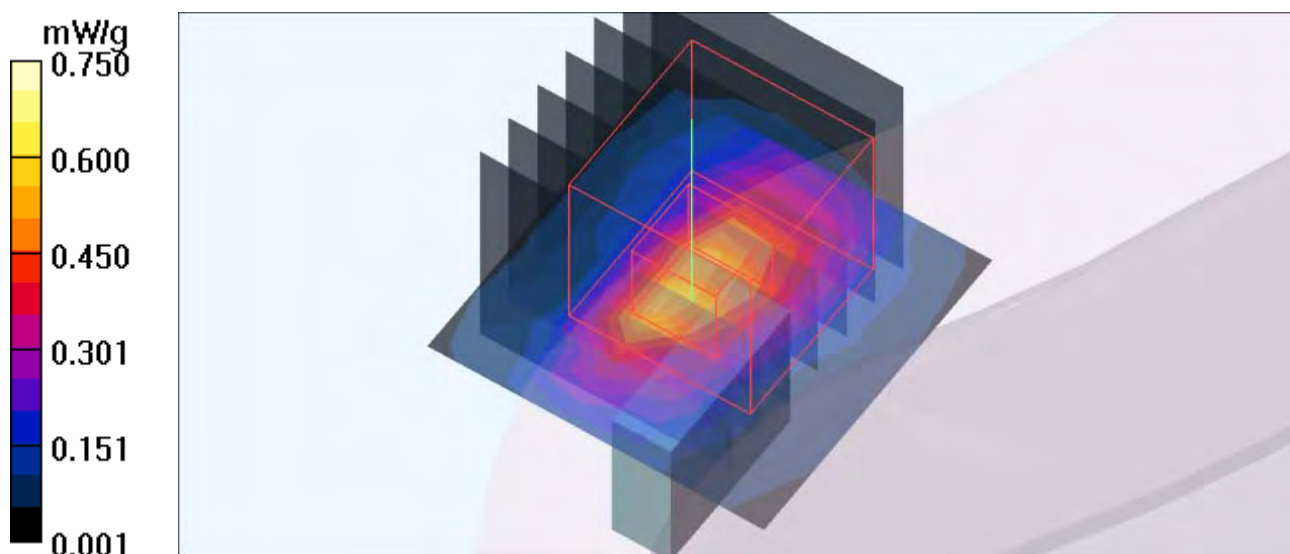
**Body Position - Low Channel 1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 14.2 V/m; Power Drift = 0.073 dB

Peak SAR (extrapolated) = 1.08 W/kg

**SAR(1 g) = 0.408 mW/g; SAR(10 g) = 0.157 mW/g**

Maximum value of SAR (measured) = 0.750 mW/g



## M14-11g-Ch6

Communication System: 802.11g ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK  
Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Vertical-back side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 6/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.629 mW/g

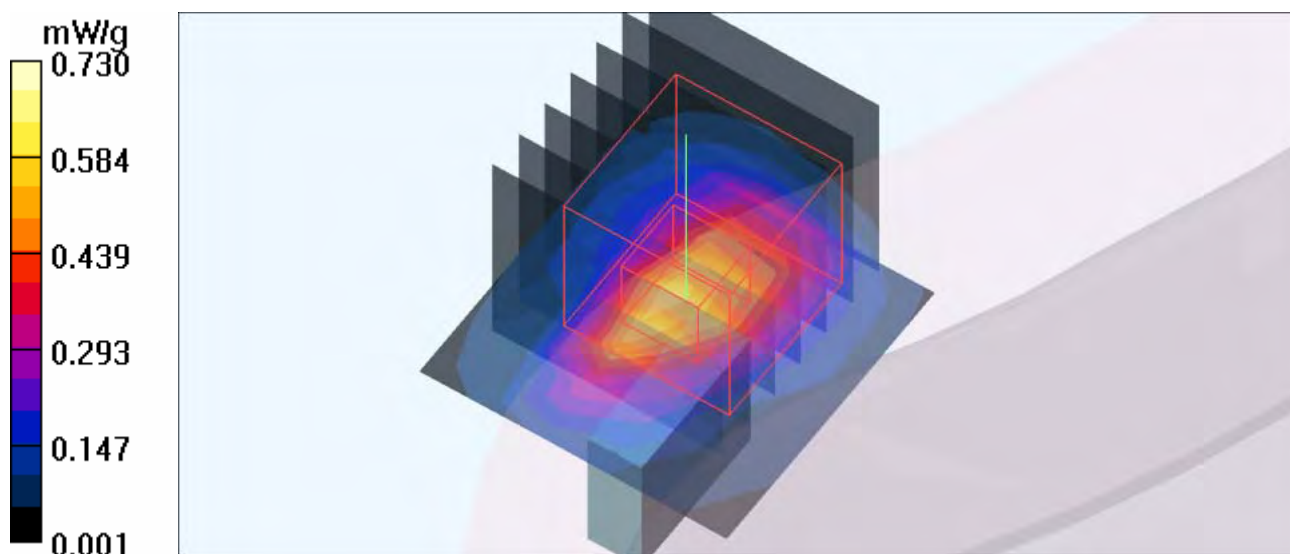
**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 12.7 V/m; Power Drift = 0.179 dB

Peak SAR (extrapolated) = 1.07 W/kg

**SAR(1 g) = 0.424 mW/g; SAR(10 g) = 0.172 mW/g**

Maximum value of SAR (measured) = 0.730 mW/g



## M15-11n20-Ch6

Communication System: 802.11n 20MHz ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Vertical-back side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 6/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.578 mW/g

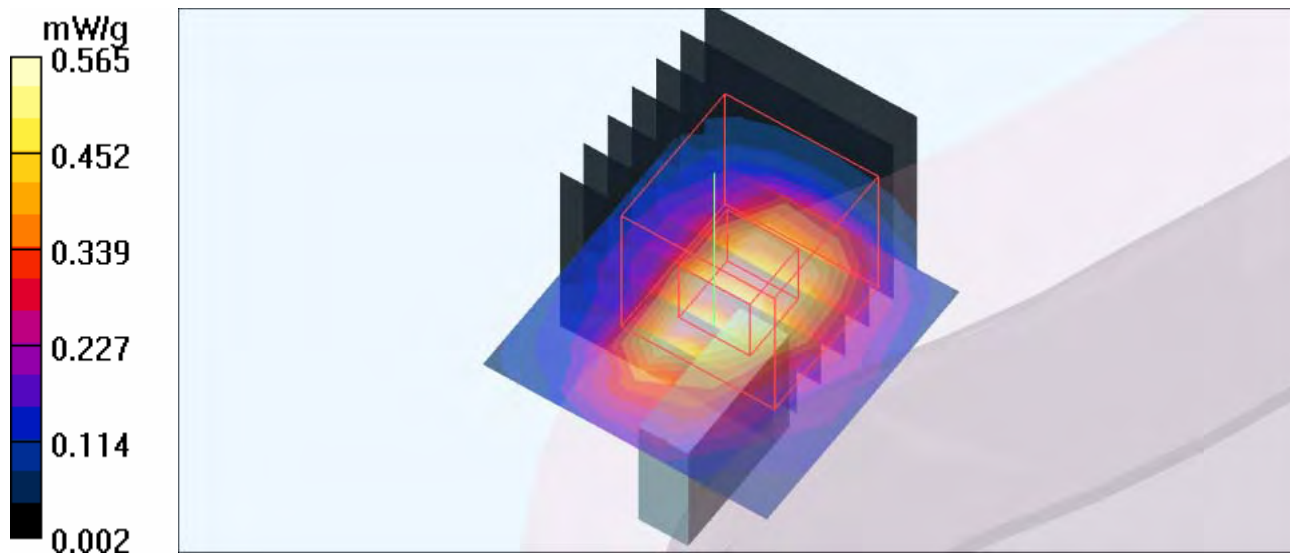
**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 16.6 V/m; Power Drift = -0.124 dB

Peak SAR (extrapolated) = 0.835 W/kg

**SAR(1 g) = 0.334 mW/g; SAR(10 g) = 0.145 mW/g**

Maximum value of SAR (measured) = 0.565 mW/g





## M16-11n40-Ch4

Communication System: 802.11n 40MHz ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The Vertical-back side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 4/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.484 mW/g

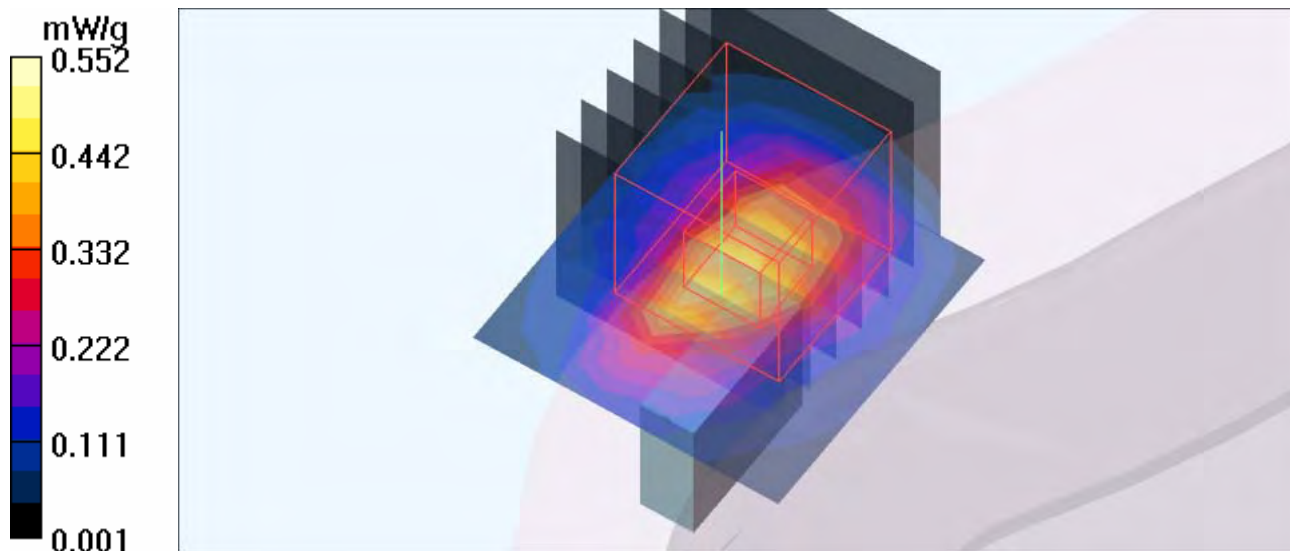
**Body Position - Mid Channel 4/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 13.0 V/m; Power Drift = -0.148 dB

Peak SAR (extrapolated) = 0.813 W/kg

**SAR(1 g) = 0.324 mW/g; SAR(10 g) = 0.138 mW/g**

Maximum value of SAR (measured) = 0.552 mW/g



## M17-11b-Ch1

Communication System: 802.11b ; Frequency: 2412 MHz ; Duty Cycle: 1:1 ; Modulation type: DBPSK  
Medium: MSL2450 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 55.05$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The tip side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Low Channel 1/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.684 mW/g

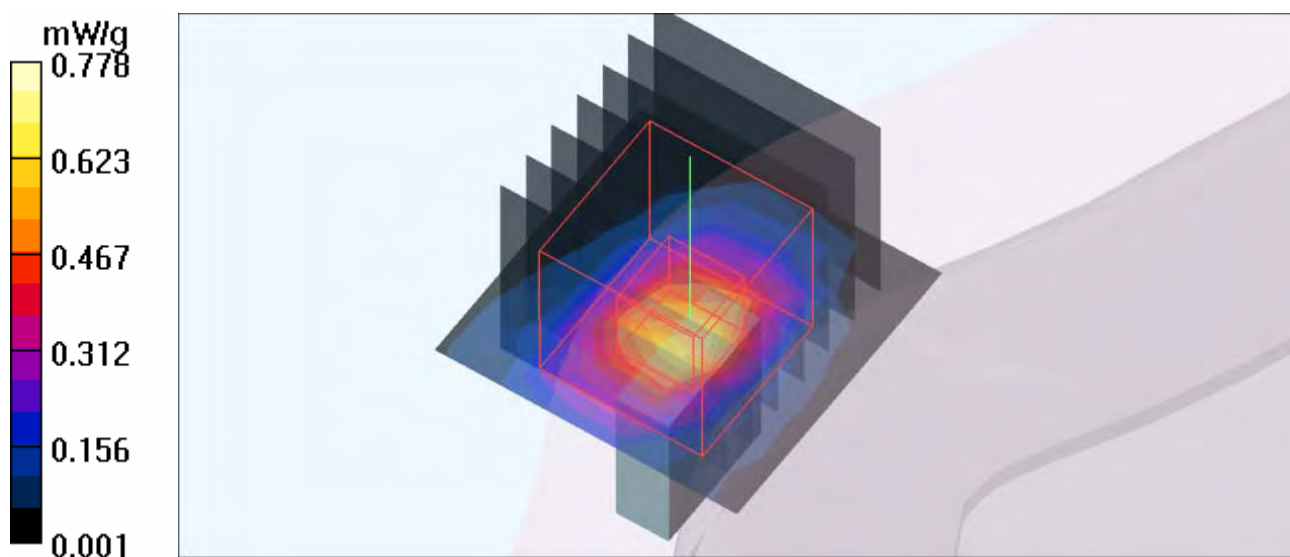
**Body Position - Low Channel 1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 20.7 V/m; Power Drift = -0.194 dB

Peak SAR (extrapolated) = 1.17 W/kg

**SAR(1 g) = 0.444 mW/g; SAR(10 g) = 0.162 mW/g**

Maximum value of SAR (measured) = 0.778 mW/g



## M18-11g-Ch6

Communication System: 802.11g ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK  
Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The tip side of the EUT to the Phantom)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 6/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.645 mW/g

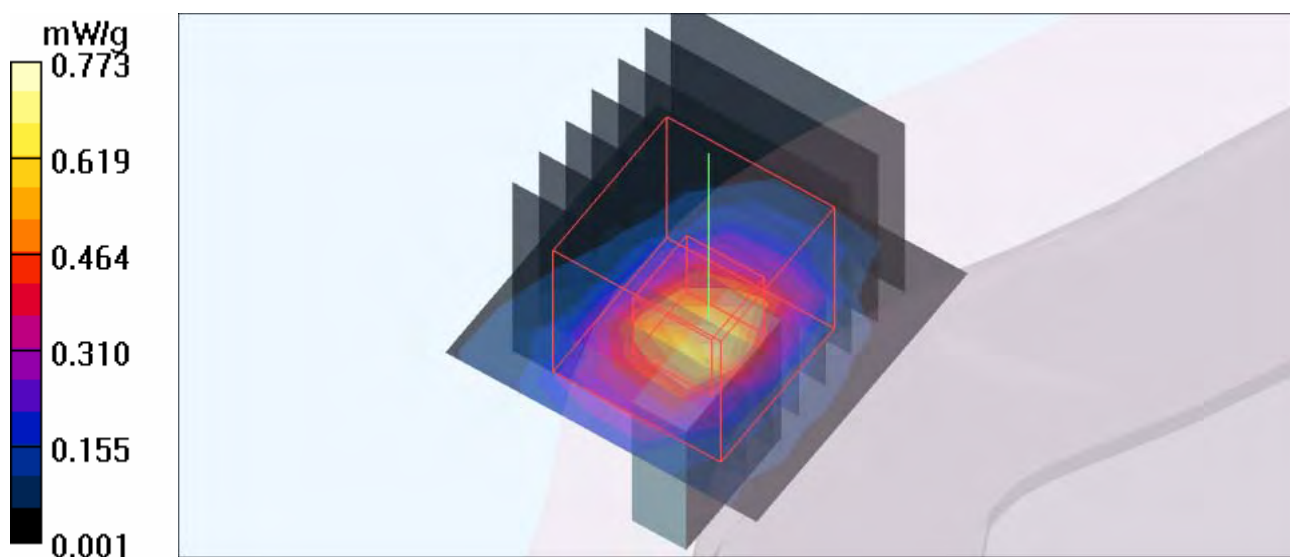
**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 20.6 V/m; Power Drift = -0.165 dB

Peak SAR (extrapolated) = 1.16 W/kg

**SAR(1 g) = 0.442 mW/g; SAR(10 g) = 0.161 mW/g**

Maximum value of SAR (measured) = 0.773 mW/g





## M19-11n20-Ch6

Communication System: 802.11n 20MHz ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The tip side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 6/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.765 mW/g

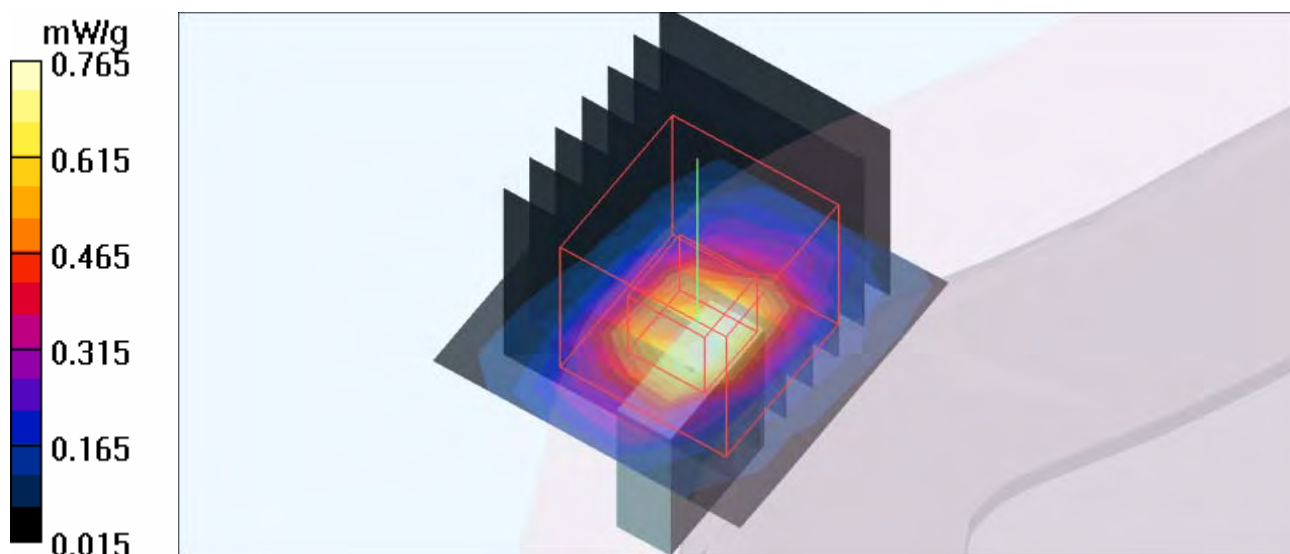
**Body Position - Mid Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 25.6 V/m; Power Drift = -0.136 dB

Peak SAR (extrapolated) = 1.11 W/kg

**SAR(1 g) = 0.425 mW/g; SAR(10 g) = 0.156 mW/g**

Maximum value of SAR (measured) = 0.754 mW/g



## M20-11n40-Ch4

Communication System: 802.11n 40MHz ; Frequency: 2437 MHz ; Duty Cycle: 1:1 ; Modulation type: BPSK

Medium: MSL2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section ; Separation distance : 5 mm (The tip side of the EUT to the Phantom)

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Body Position - Mid Channel 4/Area Scan (6x6x1):** Measurement grid: dx=8mm, dy=8mm  
Maximum value of SAR (measured) = 0.574 mW/g

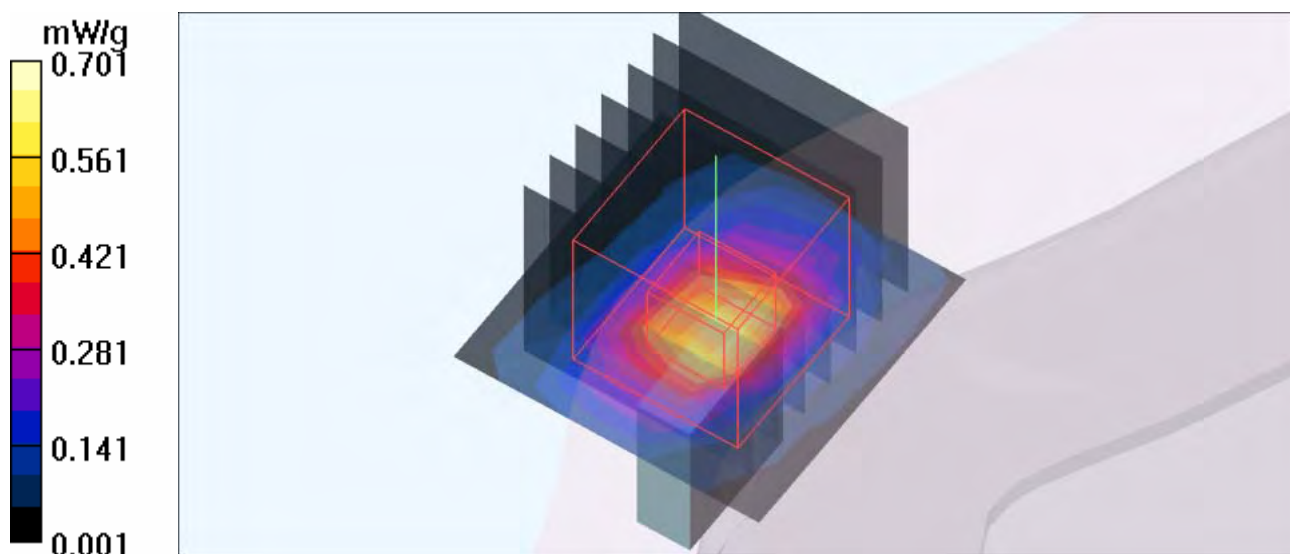
**Body Position - Mid Channel 4/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 21.2 V/m; Power Drift = -0.102 dB

Peak SAR (extrapolated) = 1.04 W/kg

**SAR(1 g) = 0.395 mW/g; SAR(10 g) = 0.145 mW/g**

Maximum value of SAR (measured) = 0.701 mW/g



## SystemPerformanceCheck-D2450V2-MSL2450MHz

**DUT: Dipole 2450 MHz ; Type: D2450V2 ; Serial: D2450V2 - SN:716 ; Test Frequency: 2450 MHz**

Communication System: CW ; Frequency: 2450 MHz; Duty Cycle: 1:1; Modulation type: CW  
 Medium: MSL2450; Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  mho/m;  $\epsilon_r = 54.76$ ;  $\rho = 1000$  kg/m<sup>3</sup> ; Liquid level : 150 mm  
 Phantom section: Flat Section ; Separation distance : 10 mm (The feet point of the dipole to the Phantom) Air temp. : 22.3 degrees ; Liquid temp. : 21.2 degrees

DASY4 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Twin Phantom V4.0; Type: QD 000 P40 CA; Serial: TP-1202
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**d=10mm, Pin=250mW/Area Scan (7x7x1):** Measurement grid: dx=15mm, dy=15mm  
 Maximum value of SAR (measured) = 14.3 mW/g

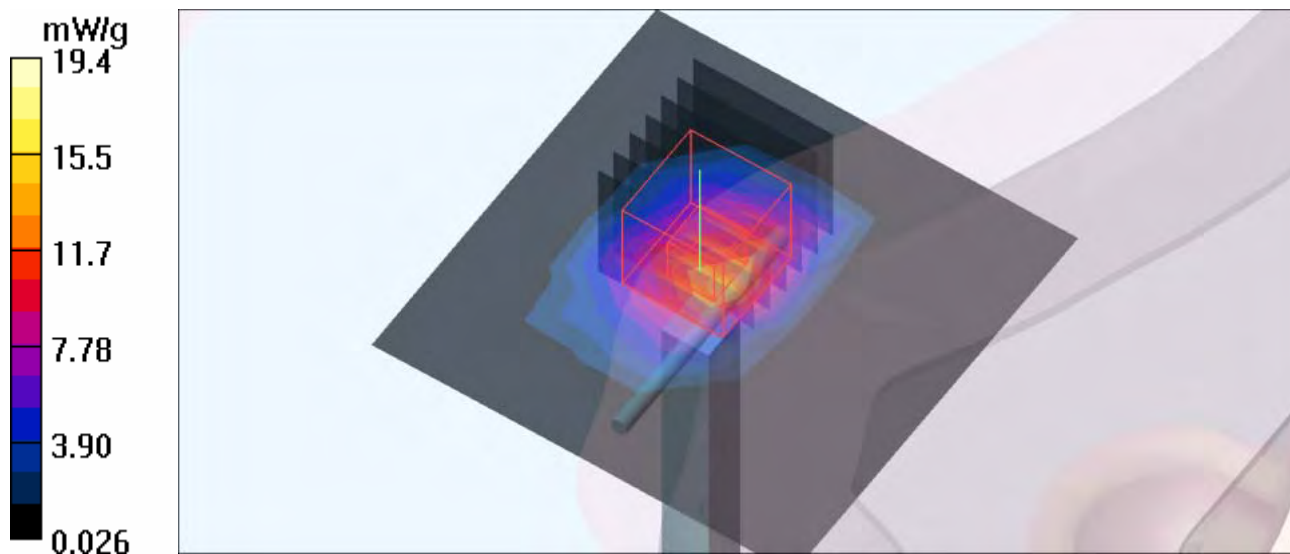
**d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.9 V/m; Power Drift = 0.006 dB

Peak SAR (extrapolated) = 10.8 W/kg

**SAR(1 g) = 12.5 mW/g; SAR(10 g) = 5.82 mW/g**

Maximum value of SAR (measured) = 19.4 mW/g



## APPENDIX B: BV ADT SAR MEASUREMENT SYSTEM



## APPENDIX C: PHOTOGRAPHS OF SYSTEM VALIDATION





## **APPENDIX D: SYSTEM CERTIFICATE & CALIBRATION**

### **D1: SAM PHANTOM**

# Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

## Certificate of conformity / First Article Inspection

|                       |  |
|-----------------------|--|
| Item                  | SAM Twin Phantom V4.0  |
| Type No               | QD 000 P40 CA  |
| Series No             | TP-1150 and higher   |
| Manufacturer / Origin | Untersee Composites<br>Hauptstr. 69<br>CH-8559 Fruthwilen<br>Switzerland |

### Tests

The series production process used allows the limitation to test of first articles. Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

| Test                 | Requirement   | Details  | Units tested              |
|----------------------|---|--|---------------------------|
| Shape                | Compliance with the geometry according to the CAD model.                                | IT'IS CAD File (*)   | First article, Samples    |
| Material thickness   | Compliant with the requirements according to the standards                              | 2mm +/- 0.2mm in specific areas                                      | First article, Samples    |
| Material parameters  | Dielectric parameters for required frequencies  | 200 MHz - 3 GHz<br>Relative permittivity < 5<br>Loss tangent < 0.05. | Material sample TP 104-5  |
| Material resistivity | The material has been tested to be compatible with the liquids defined in the standards | Liquid type HSL 1800 and others according to the standard.           | Pre-series, First article |

### Standards

- [1] CENELEC EN 50361
- [2] IEEE P1528-200x draft 6.5
- [3] IEC PT 62209 draft 0.9

(\*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

### Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date

28.02.2002

Signature / Stamp

*F. Bumbult*

**Schmid & Partner  
Engineering AG**

Zeughausstrasse 43, CH-8004 Zurich  
Tel. +41 1 245 97 00, Fax +41 1 245 97 79

*Volker Kapp*



## D2: DOSIMETRIC E-FIELD PROBE





Accredited by the Swiss Accreditation Service (SAS)  
The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **BV ADT (Auden)**

Certificate No: **EX3-3590\_Feb11**

**CALIBRATION CERTIFICATE**

Object **EX3DV4 - SN:3590**

Calibration procedure(s) **QA CAL-01.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v3  
Calibration procedure for dosimetric E-field probes**

Calibration date: **February 25, 2011**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards          | ID              | Cal Date (Certificate No.)        | Scheduled Calibration  |
|----------------------------|-----------------|-----------------------------------|------------------------|
| Power meter E4419B         | GB41293874      | 01-Apr-10 (No. 217-01136)         | Apr-11                 |
| Power sensor E4412A        | MY41495277      | 01-Apr-10 (No. 217-01136)         | Apr-11                 |
| Power sensor E4412A        | MY41498087      | 01-Apr-10 (No. 217-01136)         | Apr-11                 |
| Reference 3 dB Attenuator  | SN: S5054 (3c)  | 30-Mar-10 (No. 217-01159)         | Mar-11                 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 30-Mar-10 (No. 217-01161)         | Mar-11                 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 30-Mar-10 (No. 217-01160)         | Mar-11                 |
| Reference Probe ES3DV2     | SN: 3013        | 29-Dec-10 (No. ES3-3013_Dec10)    | Dec-11                 |
| DAE4                       | SN: 654         | 23-Apr-10 (No. DAE4-654_Apr10)    | Apr-11                 |
| Secondary Standards        | ID              | Check Date (in house)             | Scheduled Check        |
| RF generator HP 8648C      | US3642U01700    | 4-Aug-99 (in house check Oct-09)  | In house check: Oct-11 |
| Network Analyzer HP 8753E  | US37390585      | 18-Oct-01 (in house check Oct-10) | In house check: Oct-11 |

|                | Name                 | Function                 | Signature |
|----------------|----------------------|--------------------------|-----------|
| Calibrated by: | <b>Katja Pokovic</b> | <b>Technical Manager</b> |           |
| Approved by:   | <b>Niels Kuster</b>  | <b>Quality Manager</b>   |           |

Issued: February 25, 2011

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

### Glossary:

|                          |   |
|--------------------------|---|
| TSL                      | tissue simulating liquid  |
| NORM <sub>x,y,z</sub>    | sensitivity in free space   |
| ConvF                    | sensitivity in TSL / NORM <sub>x,y,z</sub>  |
| DCP                      | diode compression point   |
| CF                       | crest factor (1/duty_cycle) of the RF signal  |
| A, B, C                  | modulation dependent linearization parameters   |
| Polarization $\varphi$   | $\varphi$ rotation around probe axis  |
| Polarization $\vartheta$ | $\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center),<br>i.e., $\vartheta = 0$ is normal to probe axis |

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)<sub>x,y,z</sub>** = NORM<sub>x,y,z</sub> \* *frequency\_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>** are numerical linearization parameters in dB assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media.
- VR**: VR is the validity range of the calibration related to the average diode voltage or DAE voltage in mV.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

# Probe EX3DV4

## SN:3590

Manufactured: March 23, 2009  
Calibrated: February 25, 2011

Calibrated for DASY/EASY Systems  
(Note: non-compatible with DASY2 system!)

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3590

### Basic Calibration Parameters

|  | Sensor X | Sensor Y | Sensor Z | Unc (k=2)     |
|--|----------|----------|----------|---------------|
| Norm ( $\mu\text{V}/(\text{V/m})^2$ ) <sup>A</sup> | 0.51     | 0.48     | 0.51     | $\pm 10.1 \%$ |
| DCP (mV) <sup>B</sup>                              | 94.6     | 95.5     | 92.8     |               |

### Modulation Calibration Parameters

| UID   | Communication System Name | PAR  |   | A<br>dB | B<br>dB | C<br>dB | VR<br>mV | Unc <sup>E</sup><br>(k=2) |
|-------|---------------------------|------|---|---------|---------|---------|----------|---------------------------|
| 10000 | CW                        | 0.00 | X | 0.00    | 0.00    | 1.00    | 119.0    | $\pm 2.7 \%$              |
|       |                           |      | Y | 0.00    | 0.00    | 1.00    | 141.4    |                           |
|       |                           |      | Z | 0.00    | 0.00    | 1.00    | 115.0    |                           |

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the  $E^2$ -field uncertainty inside TSL (see Pages 5 and 6).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3590

### Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 835                  | 41.5                               | 0.90                            | 10.21   | 10.21   | 10.21   | 0.56  | 0.68       | ± 12.0 %    |
| 1640                 | 40.3                               | 1.29                            | 9.25    | 9.25    | 9.25    | 0.68  | 0.60       | ± 12.0 %    |
| 1750                 | 40.1                               | 1.37                            | 9.03    | 9.03    | 9.03    | 0.79  | 0.58       | ± 12.0 %    |
| 1950                 | 40.0                               | 1.40                            | 8.45    | 8.45    | 8.45    | 0.55  | 0.66       | ± 12.0 %    |
| 2300                 | 39.5                               | 1.67                            | 8.14    | 8.14    | 8.14    | 0.40  | 0.80       | ± 12.0 %    |
| 2450                 | 39.2                               | 1.80                            | 7.73    | 7.73    | 7.73    | 0.29  | 1.00       | ± 12.0 %    |
| 2600                 | 39.0                               | 1.96                            | 7.53    | 7.53    | 7.53    | 0.28  | 1.06       | ± 12.0 %    |
| 3500                 | 37.9                               | 2.91                            | 7.55    | 7.55    | 7.55    | 0.36  | 1.03       | ± 13.1 %    |
| 5200                 | 36.0                               | 4.66                            | 5.51    | 5.51    | 5.51    | 0.30  | 1.80       | ± 13.1 %    |
| 5300                 | 35.9                               | 4.76                            | 5.17    | 5.17    | 5.17    | 0.30  | 1.80       | ± 13.1 %    |
| 5500                 | 35.6                               | 4.96                            | 5.00    | 5.00    | 5.00    | 0.40  | 1.80       | ± 13.1 %    |
| 5600                 | 35.5                               | 5.07                            | 4.52    | 4.52    | 4.52    | 0.50  | 1.80       | ± 13.1 %    |
| 5800                 | 35.3                               | 5.27                            | 4.53    | 4.53    | 4.53    | 0.50  | 1.80       | ± 13.1 %    |

<sup>C</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

## DASY/EASY - Parameters of Probe: EX3DV4- SN:3590

### Calibration Parameter Determined in Body Tissue Simulating Media

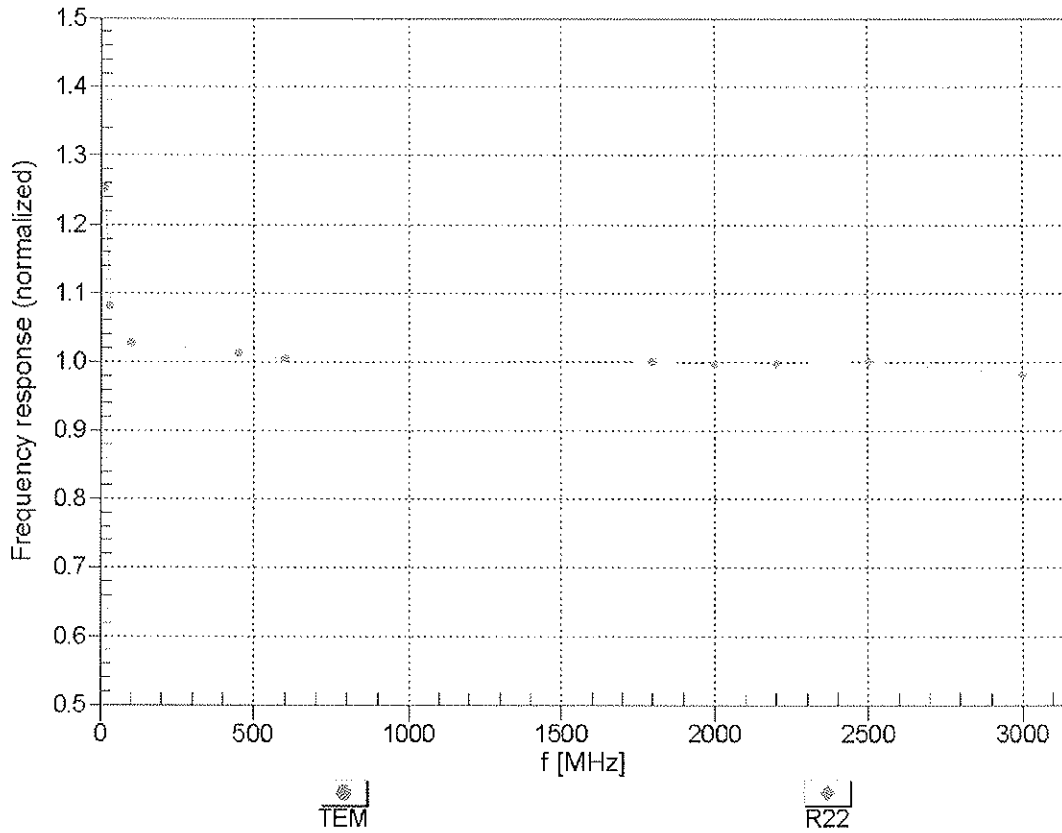
| f (MHz) <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 835                  | 55.2                               | 0.97                            | 10.32   | 10.32   | 10.32   | 0.38  | 0.82       | ± 12.0 %    |
| 1640                 | 53.8                               | 1.40                            | 9.72    | 9.72    | 9.72    | 0.51  | 0.79       | ± 12.0 %    |
| 1750                 | 53.4                               | 1.49                            | 8.77    | 8.77    | 8.77    | 0.37  | 0.92       | ± 12.0 %    |
| 1950                 | 53.3                               | 1.52                            | 8.49    | 8.49    | 8.49    | 0.60  | 0.67       | ± 12.0 %    |
| 2300                 | 52.9                               | 1.81                            | 8.08    | 8.08    | 8.08    | 0.30  | 1.00       | ± 12.0 %    |
| 2450                 | 52.7                               | 1.95                            | 7.91    | 7.91    | 7.91    | 0.42  | 0.82       | ± 12.0 %    |
| 2600                 | 52.5                               | 2.16                            | 7.78    | 7.78    | 7.78    | 0.25  | 1.17       | ± 12.0 %    |
| 3500                 | 51.3                               | 3.31                            | 7.14    | 7.14    | 7.14    | 0.43  | 0.96       | ± 13.1 %    |
| 5200                 | 49.0                               | 5.30                            | 4.81    | 4.81    | 4.81    | 0.50  | 1.90       | ± 13.1 %    |
| 5300                 | 48.9                               | 5.42                            | 4.56    | 4.56    | 4.56    | 0.50  | 1.90       | ± 13.1 %    |
| 5500                 | 48.6                               | 5.65                            | 4.32    | 4.32    | 4.32    | 0.50  | 1.90       | ± 13.1 %    |
| 5600                 | 48.5                               | 5.77                            | 4.01    | 4.01    | 4.01    | 0.60  | 1.90       | ± 13.1 %    |
| 5800                 | 48.2                               | 6.00                            | 4.55    | 4.55    | 4.55    | 0.50  | 1.90       | ± 13.1 %    |

<sup>C</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

# Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)

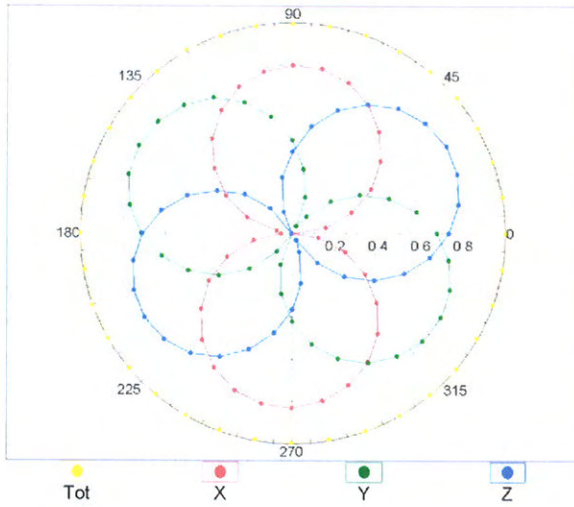


Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

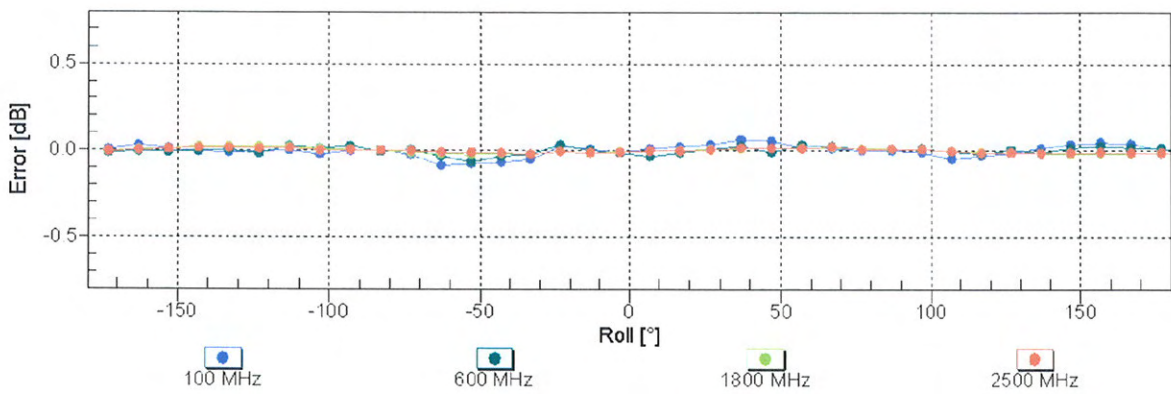
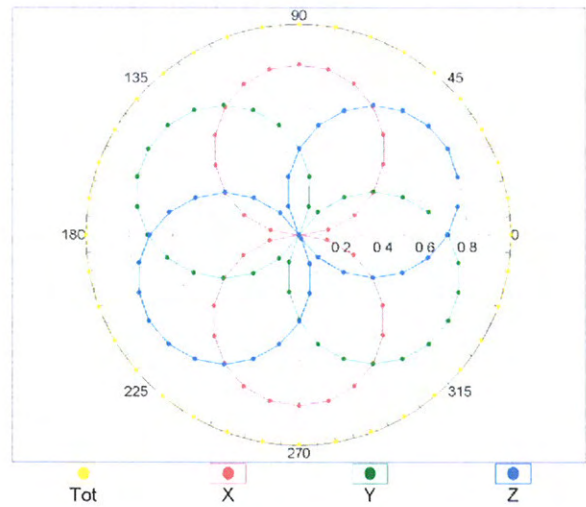


### Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$

f=600 MHz, TEM



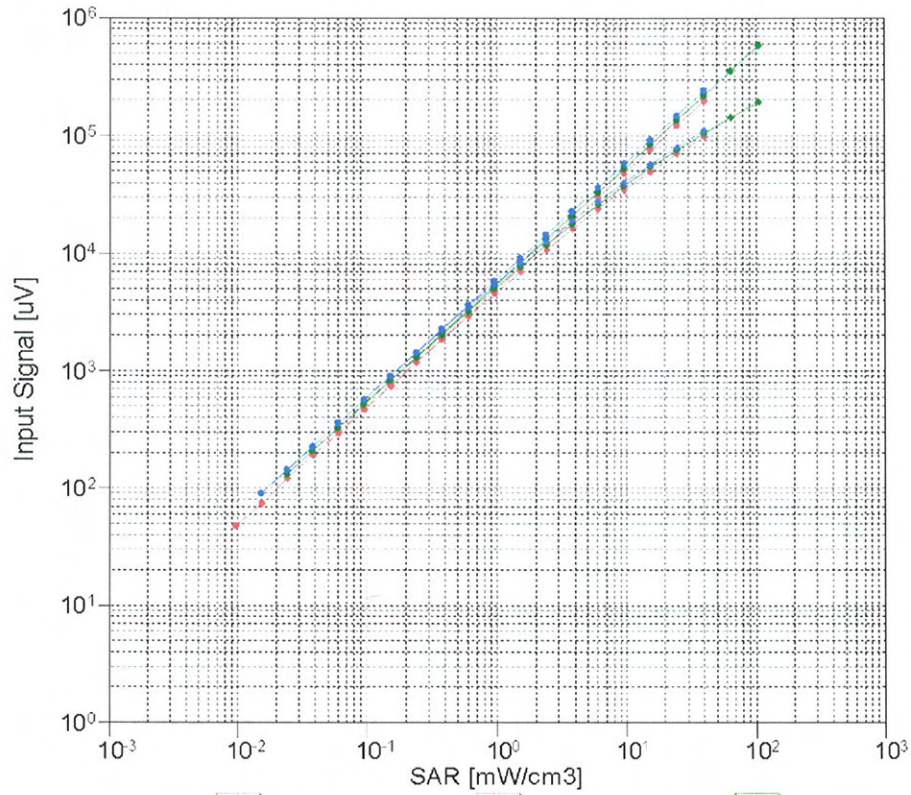
f=1800 MHz, R22



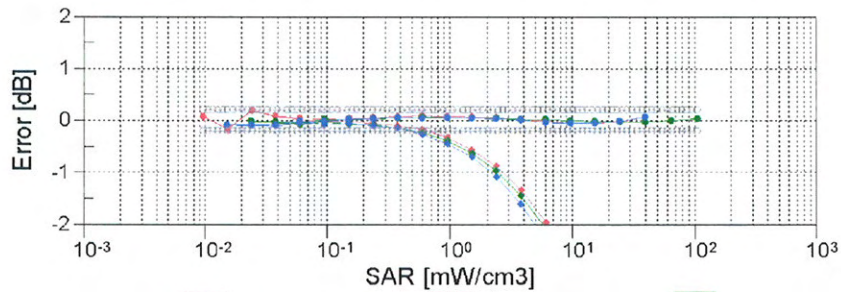
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)



### Dynamic Range f(SAR<sub>head</sub>) (TEM cell , f = 900 MHz)



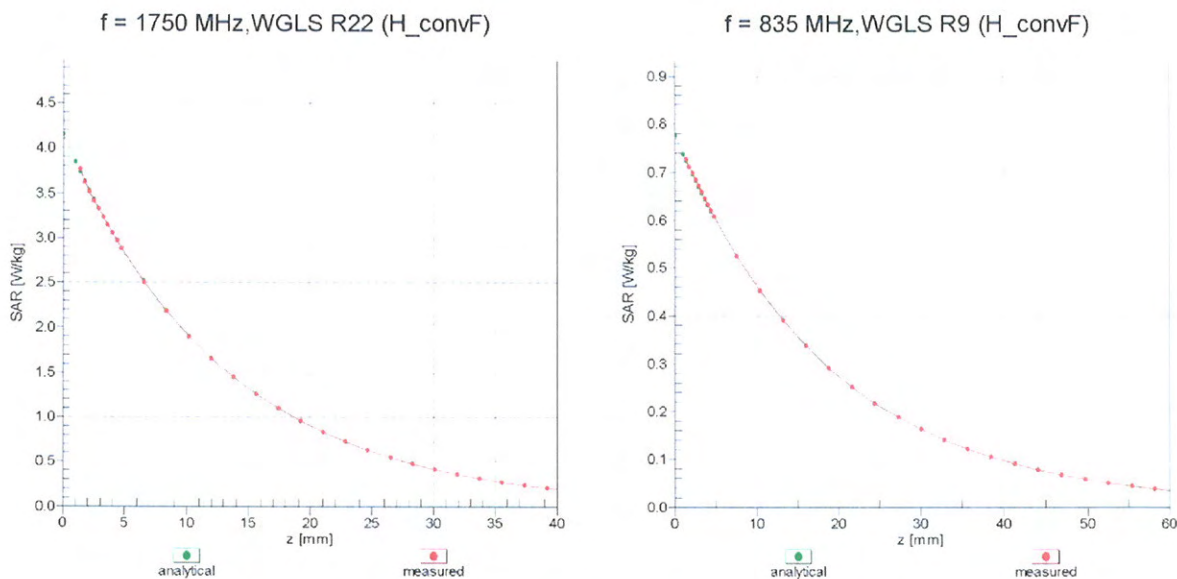
X compensated      X not compensated      Y compensated  
Y not compensated      Z compensated      Z not compensated



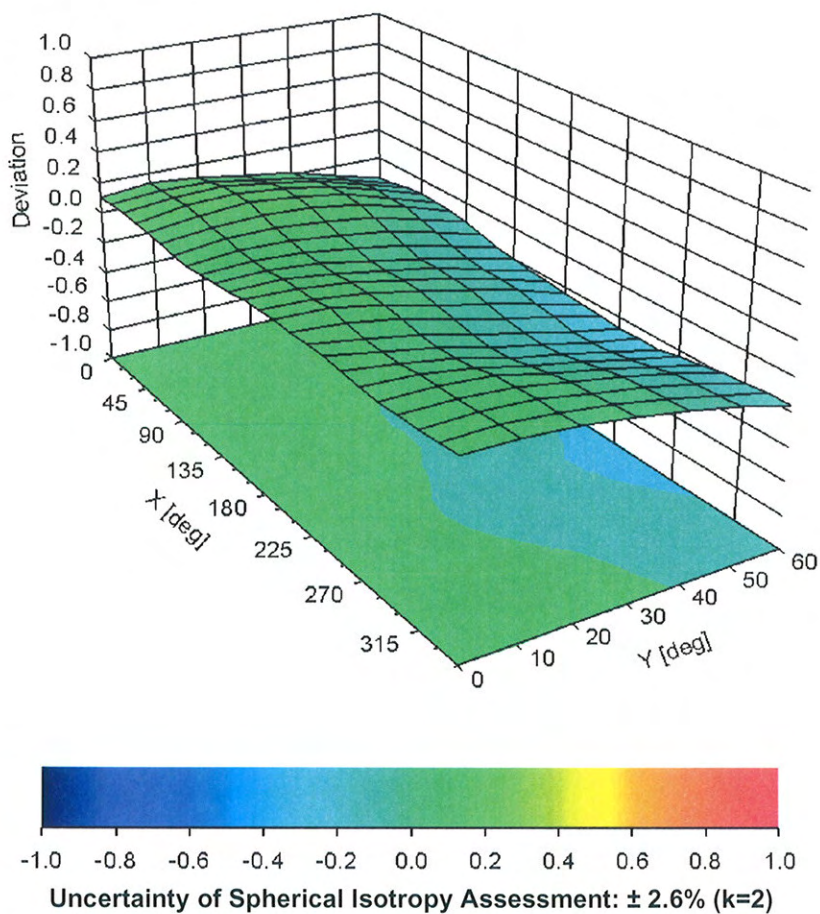
X compensated      X not compensated      Y compensated  
Y not compensated      Z compensated      Z not compensated

Uncertainty of Linearity Assessment: ± 0.6% (k=2)

# Conversion Factor Assessment



## Deviation from Isotropy in Air Error ( $\phi, \vartheta$ ), f = 900 MHz



## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3590

### Other Probe Parameters

|   |                |
|---|----------------|
| Sensor Arrangement                            | Triangular     |
| Connector Angle (°)                           | Not applicable |
| Mechanical Surface Detection Mode             | enabled        |
| Optical Surface Detection Mode                | disabled       |
| Probe Overall Length                          | 337 mm         |
| Probe Body Diameter                           | 10 mm          |
| Tip Length                                    | 9 mm           |
| Tip Diameter                                  | 2.5 mm         |
| Probe Tip to Sensor X Calibration Point       | 1 mm           |
| Probe Tip to Sensor Y Calibration Point       | 1 mm           |
| Probe Tip to Sensor Z Calibration Point       | 1 mm           |
| Recommended Measurement Distance from Surface | 2 mm           |



A D T

**D3: DAE**



## IMPORTANT NOTICE

### USAGE OF THE DAE 3

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

**Battery Exchange:** The battery cover of the DAE3 unit is connected to a fragile 3-pin battery connector. Customer is responsible to apply utmost caution not to bend or damage the connector when changing batteries.

**Shipping of the DAE:** Before shipping the DAE to SPEAG for calibration the customer shall remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts transportation. The package shall be marked to indicate that a fragile instrument is inside.

**E-Stop Failures:** Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, Customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

**Repair:** Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

**DASY Configuration Files:** Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

**Important Note:**

**Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.**

**Important Note:**

**Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.**

**Important Note:**

**To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.**





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Accreditation No.: **SCS 108**

Client **BV-ADT (Auden)**

Certificate No: **DAE3-579\_Sep10**

## CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 579**

Calibration procedure(s) **QA CAL-06.v22  
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **September 20, 2010**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards             | ID #               | Cal Date (Certificate No.) | Scheduled Calibration  |
|-------------------------------|--------------------|----------------------------|------------------------|
| Keithley Multimeter Type 2001 | SN: 0810278        | 1-Oct-09 (No: 9055)        | Oct-10                 |
| Secondary Standards           | ID #               | Check Date (in house)      | Scheduled Check        |
| Calibrator Box V1.1           | SE UMS 006 AB 1004 | 07-Jun-10 (in house check) | In house check: Jun-11 |

|                | Name              | Function     | Signature |
|----------------|-------------------|--------------|-----------|
| Calibrated by: | Dominique Steffen | Technician   |           |
| Approved by:   | Fin Bomholt       | R&D Director |           |

Issued: September 20, 2010

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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Multilateral Agreement for the recognition of calibration certificates

## Glossary

DAE data acquisition electronics  
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

## Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity*: Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity*: Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation*: Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted*: Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current*: Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance*: Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage*: Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption*: Typical value for information. Supply currents in various operating modes.

## DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 $\mu$ V, full range = -100...+300 mV

Low Range: 1LSB = 61nV, full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X                        | Y                        | Z                        |
|---------------------|--------------------------|--------------------------|--------------------------|
| High Range          | 404.327 $\pm$ 0.1% (k=2) | 404.379 $\pm$ 0.1% (k=2) | 404.160 $\pm$ 0.1% (k=2) |
| Low Range           | 3.98675 $\pm$ 0.7% (k=2) | 3.99301 $\pm$ 0.7% (k=2) | 3.94834 $\pm$ 0.7% (k=2) |

## Connector Angle

|   |                                     |
|---|-------------------------------------|
| Connector Angle to be used in DASY system | 358.0 $^{\circ}$ $\pm$ 1 $^{\circ}$ |
|---|-------------------------------------|



## Appendix

### 1. DC Voltage Linearity

| High Range |         | Reading ( $\mu\text{V}$ ) | Difference ( $\mu\text{V}$ ) | Error (%) |
|------------|---------|---------------------------|------------------------------|-----------|
| Channel X  | + Input | 200003.9                  | 0.96                         | 0.00      |
| Channel X  | + Input | 20003.19                  | 3.09                         | 0.02      |
| Channel X  | - Input | -19994.55                 | 4.75                         | -0.02     |
| Channel Y  | + Input | 199992.4                  | -0.09                        | -0.00     |
| Channel Y  | + Input | 19999.51                  | 0.41                         | 0.00      |
| Channel Y  | - Input | -19997.22                 | 3.18                         | -0.02     |
| Channel Z  | + Input | 200002.0                  | 0.91                         | 0.00      |
| Channel Z  | + Input | 20001.93                  | 2.03                         | 0.01      |
| Channel Z  | - Input | -19997.58                 | 2.82                         | -0.01     |

| Low Range |         | Reading ( $\mu\text{V}$ ) | Difference ( $\mu\text{V}$ ) | Error (%) |
|-----------|---------|---------------------------|------------------------------|-----------|
| Channel X | + Input | 2000.0                    | 0.02                         | 0.00      |
| Channel X | + Input | 199.82                    | 0.12                         | 0.06      |
| Channel X | - Input | -200.46                   | -0.56                        | 0.28      |
| Channel Y | + Input | 2000.3                    | 0.47                         | 0.02      |
| Channel Y | + Input | 199.12                    | -0.78                        | -0.39     |
| Channel Y | - Input | -201.36                   | -1.16                        | 0.58      |
| Channel Z | + Input | 1999.9                    | -0.07                        | -0.00     |
| Channel Z | + Input | 199.18                    | -0.72                        | -0.36     |
| Channel Z | - Input | -201.47                   | -1.47                        | 0.73      |

### 2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

|           | Common mode Input Voltage (mV) | High Range Average Reading ( $\mu\text{V}$ ) | Low Range Average Reading ( $\mu\text{V}$ ) |
|-----------|--------------------------------|--|---|
| Channel X | 200                            | 7.07   | 5.75  |
|           | - 200                          | -4.60  | -6.25                                       |
| Channel Y | 200                            | 9.48   | 9.62  |
|           | - 200                          | -10.39                                       | -10.96                                      |
| Channel Z | 200                            | 8.79   | 8.42  |
|           | - 200                          | -9.64  | -9.80                                       |

### 3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

|           | Input Voltage (mV) | Channel X ( $\mu\text{V}$ ) | Channel Y ( $\mu\text{V}$ ) | Channel Z ( $\mu\text{V}$ ) |
|-----------|--------------------|-----------------------------|-----------------------------|-----------------------------|
| Channel X | 200                | -                           | 0.03                        | 0.35                        |
| Channel Y | 200                | 1.14                        | -                           | 2.31                        |
| Channel Z | 200                | 2.01                        | 0.80                        | -                           |

#### 4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

|           | High Range (LSB) | Low Range (LSB) |
|-----------|------------------|-----------------|
| Channel X | 16343            | 16314           |
| Channel Y | 16194            | 16427           |
| Channel Z | 15816            | 16265           |

#### 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M $\Omega$

|           | Average ( $\mu$ V) | min. Offset ( $\mu$ V) | max. Offset ( $\mu$ V) | Std. Deviation ( $\mu$ V) |
|-----------|--------------------|------------------------|------------------------|---------------------------|
| Channel X | -0.70              | -1.94                  | 0.80                   | 0.49                      |
| Channel Y | -1.55              | -2.12                  | -0.66                  | 0.27                      |
| Channel Z | 0.57               | -0.11                  | 5.61                   | 0.62                      |

#### 6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

#### 7. Input Resistance (Typical values for information)

|           | Zeroing (kOhm) | Measuring (MOhm) |
|-----------|----------------|------------------|
| Channel X | 200            | 200              |
| Channel Y | 200            | 200              |
| Channel Z | 200            | 200              |

#### 8. Low Battery Alarm Voltage (Typical values for information)

| Typical values | Alarm Level (VDC) |
|----------------|-------------------|
| Supply (+ Vcc) | +7.9              |
| Supply (- Vcc) | -7.6              |

#### 9. Power Consumption (Typical values for information)

| Typical values | Switched off (mA) | Stand by (mA) | Transmitting (mA) |
|----------------|-------------------|---------------|-------------------|
| Supply (+ Vcc) | +0.01             | +6            | +14               |
| Supply (- Vcc) | -0.01             | -8            | -9                |



## D4: SYSTEM VALIDATION DIPOLE



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **B.V. ADT (Auden)**

Certificate No: **D2450V2-716\_Jan11**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 716**

Calibration procedure(s) **QA CAL-05.v8  
Calibration procedure for dipole validation kits**

Calibration date: **January 26, 2011**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^\circ\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter EPM-442A        | GB37480704         | 06-Oct-10 (No. 217-01266)         | Oct-11                 |
| Power sensor HP 8481A       | US37292783         | 06-Oct-10 (No. 217-01266)         | Oct-11                 |
| Reference 20 dB Attenuator  | SN: 5086 (20g)     | 30-Mar-10 (No. 217-01158)         | Mar-11                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 30-Mar-10 (No. 217-01162)         | Mar-11                 |
| Reference Probe ES3DV3      | SN: 3205           | 30-Apr-10 (No. ES3-3205_Apr10)    | Apr-11                 |
| DAE4                        | SN: 601            | 10-Jun-10 (No. DAE4-601_Jun10)    | Jun-11                 |
| Secondary Standards         | ID #               | Check Date (in house)             | Scheduled Check        |
| Power sensor HP 8481A       | MY41092317         | 18-Oct-02 (in house check Oct-09) | In house check: Oct-11 |
| RF generator R&S SMT-06     | 100005             | 4-Aug-99 (in house check Oct-09)  | In house check: Oct-11 |
| Network Analyzer HP 8753E   | US37390585 S4206   | 18-Oct-01 (in house check Oct-10) | In house check: Oct-11 |

| Calibrated by: | Name          | Function              | Signature |
|----------------|---------------|-----------------------|-----------|
|                | Dimce Iliev   | Laboratory Technician |           |
| Approved by:   | Katja Pokovic | Technical Manager     |           |

Issued: January 27, 2011

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Accreditation No.: **SCS 108**

### Glossary:

|       |                                 |
|-------|---------------------------------|
| TSL   | tissue simulating liquid        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:* SAR measured at the stated antenna input power.
- SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

|                              |                           |             |
|------------------------------|---------------------------|-------------|
| DASY Version                 | DASY5                     | V52.6       |
| Extrapolation                | Advanced Extrapolation    |             |
| Phantom                      | Modular Flat Phantom V5.0 |             |
| Distance Dipole Center - TSL | 10 mm                     | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm         |             |
| Frequency                    | 2450 MHz $\pm$ 1 MHz      |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                  | Temperature         | Permittivity   | Conductivity         |
|----------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters      | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters     | (22.0 $\pm$ 0.2) °C | 37.9 $\pm$ 6 % | 1.74 mho/m $\pm$ 6 % |
| Head TSL temperature during test | (20.5 $\pm$ 0.2) °C | ----           | ----                 |

## SAR result with Head TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |  |
|---|--------------------|--|
| SAR measured  | 250 mW input power | 13.6 mW / g                                      |
| SAR normalized  | normalized to 1W   | 54.4 mW / g                                      |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>54.8 mW / g <math>\pm</math> 17.0 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |  |
|---|--------------------|--|
| SAR measured  | 250 mW input power | 6.37 mW / g                                      |
| SAR normalized  | normalized to 1W   | 25.5 mW / g                                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>25.5 mW / g <math>\pm</math> 16.5 % (k=2)</b> |

## Body TSL parameters

The following parameters and calculations were applied.

|                                  | Temperature     | Permittivity | Conductivity     |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters      | 22.0 °C         | 52.7         | 1.95 mho/m       |
| Measured Body TSL parameters     | (22.0 ± 0.2) °C | 52.5 ± 6 %   | 1.96 mho/m ± 6 % |
| Body TSL temperature during test | (20.8 ± 0.2) °C | ----         | ----             |

## SAR result with Body TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                                   |
|---|--------------------|-----------------------------------|
| SAR measured  | 250 mW input power | 13.4 mW / g                       |
| SAR normalized  | normalized to 1W   | 53.6 mW / g                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>53.3 mW / g ± 17.0 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                   |
|---|--------------------|-----------------------------------|
| SAR measured  | 250 mW input power | 6.22 mW / g                       |
| SAR normalized  | normalized to 1W   | 24.9 mW / g                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>24.8 mW / g ± 16.5 % (k=2)</b> |

## Appendix

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 55.0 $\Omega$ + 2.1 j $\Omega$ |
| Return Loss                          | - 25.7 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.1 $\Omega$ + 4.4 j $\Omega$ |
| Return Loss                          | - 27.2 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.143 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

|                 |                    |
|-----------------|--------------------|
| Manufactured by | SPEAG              |
| Manufactured on | September 10, 2002 |



## DASY5 Validation Report for Head TSL

Date/Time: 24.01.2011 13:05:38

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:716**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.75$  mho/m;  $\epsilon_r = 38.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

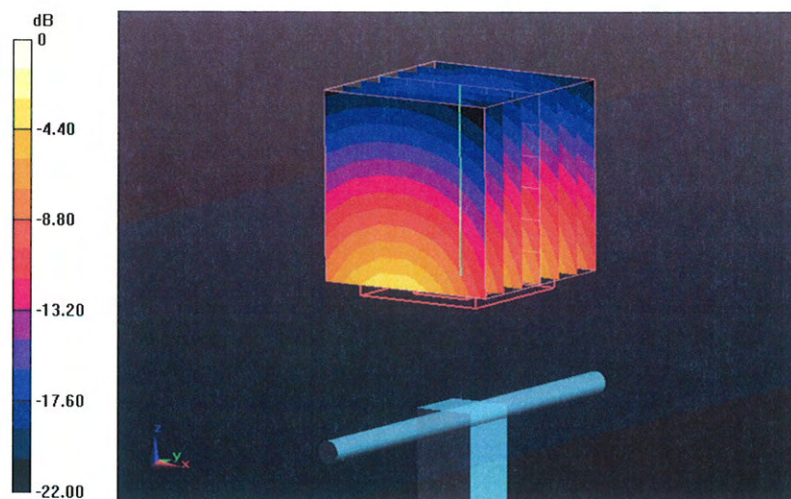
**Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.2 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.976 W/kg

**SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.37 mW/g**

Maximum value of SAR (measured) = 17.366 mW/g

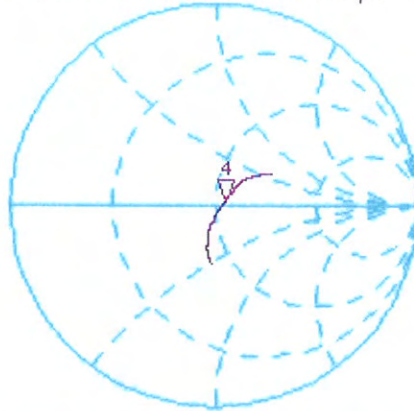


# Impedance Measurement Plot for Head TSL

24 Jan 2011 10:25:33

CH1 S11 1 U FS 4: 55.020  $\Omega$  2.0840  $\Omega$  135.38 pF 2 450.000 000 MHz

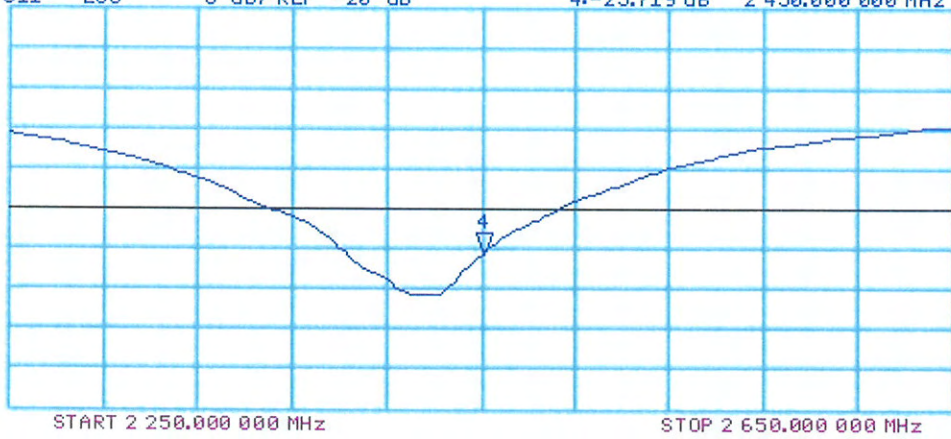
\*  
De l  
CΔ



Avg  
16  
↑

CH2 S11 LOG 5 dB/REF -20 dB 4: -25.719 dB 2 450.000 000 MHz

CΔ  
Avg  
16  
↑



## DASY5 Validation Report for Body TSL

Date/Time: 26.01.2011 13:56:41

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:716**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL U12 BB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.97$  mho/m;  $\epsilon_r = 52.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

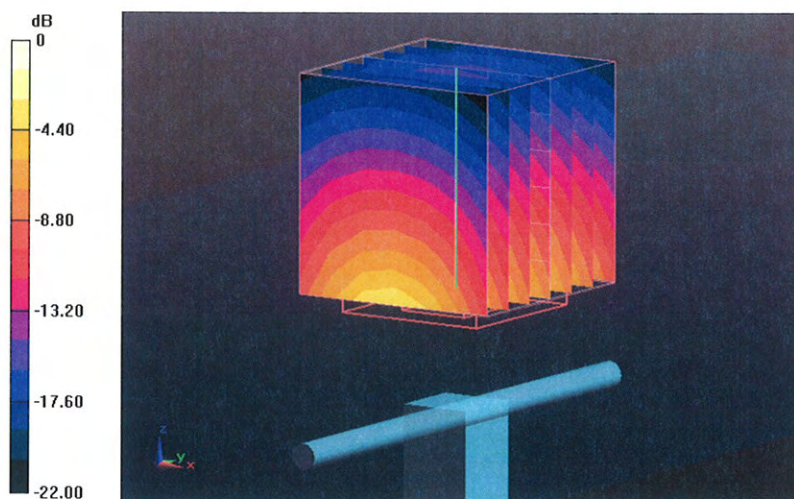
**Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.445 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 28.276 W/kg

**SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.22 mW/g**

Maximum value of SAR (measured) = 17.680 mW/g



0 dB = 17.680mW/g

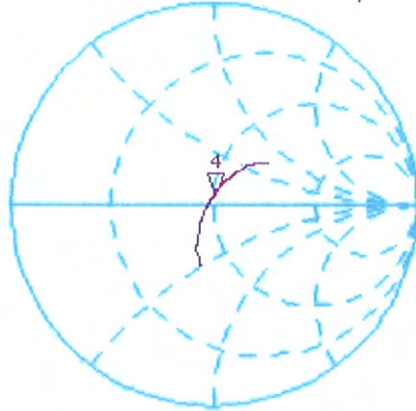


# Impedance Measurement Plot for Body TSL

26 Jan 2011 10:53:07

[CH1] S11 1 U FS 4: 50.141  $\Omega$  4.3887  $\Omega$  285.09  $\mu$ H 2 450.000 000 MHz

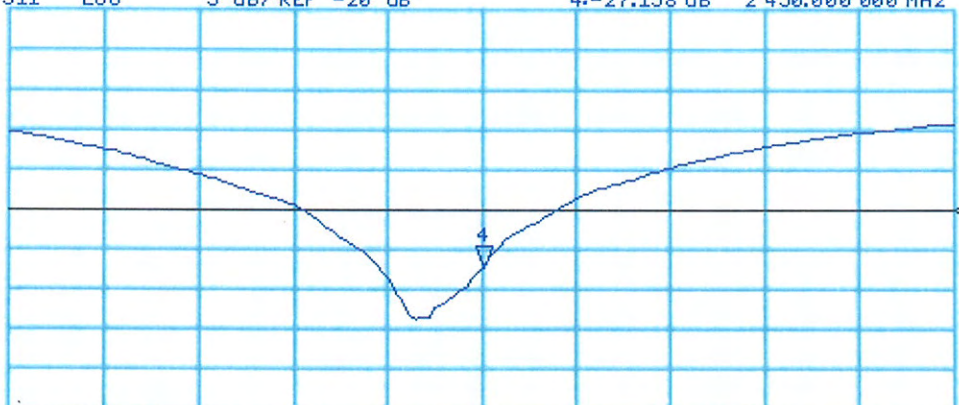
\*  
Del  
CA



Avg  
16  
↑

CH2 S11 LOG 5 dB/REF -20 dB 4:-27.158 dB 2 450.000 000 MHz

CA  
Avg  
16  
↑



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz